The Talent Imperative

BUILDING KANSAS' CAPACITY IN MATHEMATICS, ENGINEERING, TECHNOLOGY, AND SCIENCE

January 2008

Prepared by Building Engineering & Science Talent

About this Data Book

This data book was assembled to help inform the work of the Kansas Legislature's Advisory Committee on Mathematics, Science, & Innovation. The Committee met monthly from September through December 2007 under the chairmanship of Senator Nick Jordan and co-chairmanship of Representative Kenny Wilk. Drawing upon the experience and insights of legislators, educators, and private sector representatives, the Committee took a fresh overall look at the challenge of equipping Kansans with the skills needed to underpin the state's prosperity in a 21st century economy. A list of Committee members is on Appendix I.

The data presented are meant to illuminate two basic questions. First, why does building capacity in mathematics, engineering, technology, and science (METS) matter to the nation as a whole and especially to the state of Kansas? Second, where does Kansas stand? The effort was made possible by a grant from the Ewing Marion Kauffman Foundation to Building Engineering and Science Talent (BEST), an independent San Diego-based non-profit organization that specializes in education and workforce development in technical fields. BEST assembled a comparable data book for the state of Missouri in 2006.

This project could not have been completed on the timeline requested by the Committee without its active engagement as well as that of concerned government agencies. BEST wishes to thank the chair, co-chair, and members of the Committee for their helpful insights every step of the way. The Kansas Department of Education, Board of Regents, and Department of Labor also provided their full cooperation. In addition, BEST was able to draw upon site visits to Kansas State University and the University of Kansas. Sharon Wenger, a research analyst in the Kansas Legislative Research Department, played an indispensable coordinating role. BEST also wishes to thank Dr. Linda Rosen, president of Education and Management Innovations, Inc. and former Mathematics Advisor to U.S. Secretary of Education Richard Riley; and Dr. Robert D. Muller, founder, Practical Strategy LLC, and former Deputy Assistant Secretary of Education, for sharing their insights.

BEST assumes sole responsibility for the selection and interpretation of the data presented here.

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Section I: Why METS and Innovation Matter for the U.S.

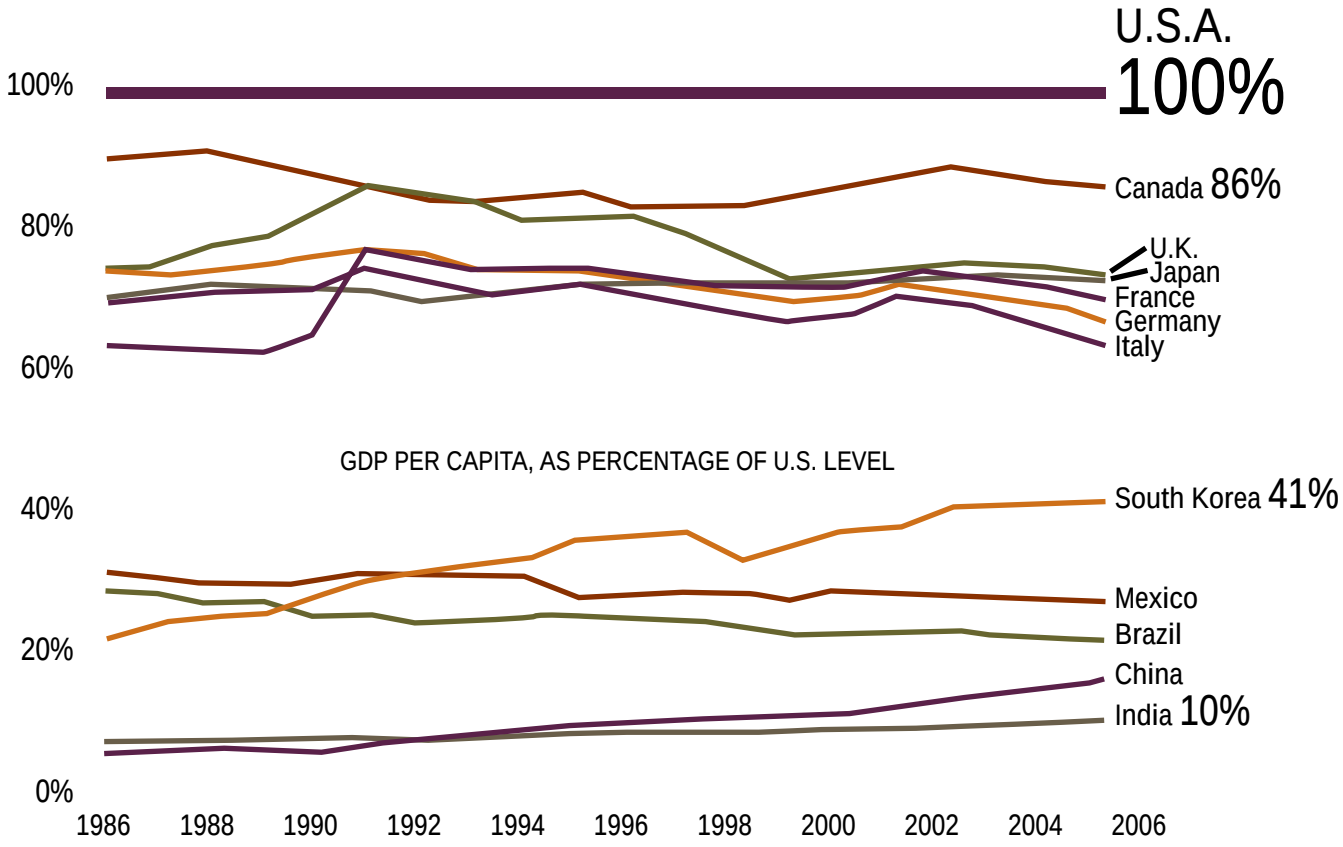
National Indicators

The United States comprises five percent of the world's population and produces 20 percent of global economic output. Technological innovation lies at the heart of this economic capacity. Half of our nation's growth stems from the creation of new knowledge and its translation into high-value products and services. The power that flows from U.S. strength in mathematics, engineering, technology and science (METS) makes the U.S. workforce the world's most productive and underpins the world's highest standard of living.

U.S. leadership cannot be taken for granted in today's global economy. Others are racing to catch up - making investments in education, infrastructure, and R&D that will position them to capture the high end of the value chain. A recent report of the National Academy of Sciences aptly described the forces at work as a "gathering storm" that requires a nationwide call to action. This section highlights some of the international and domestic indicators that have made METS a focal point of concern leading to passage of the 2007 America Competes Act.

Why METS and Innovation Matter for the U.S.

The United States leads all major economies in per capita GDP

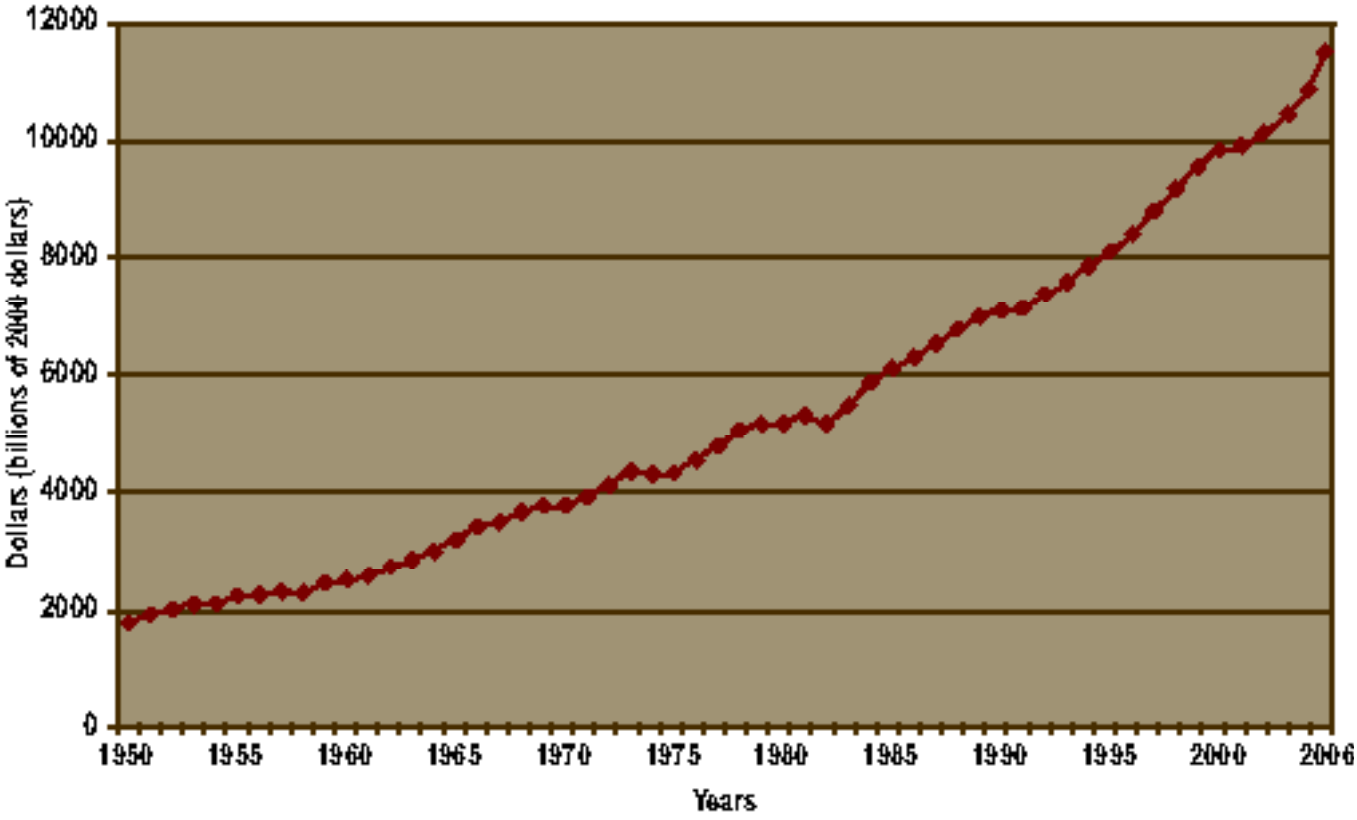


Source: Competitiveness Index: Where America Stands. Council on Competitiveness, 2006.

Why METS and Innovation Matter for the U.S.

Technological innovation accounts for 50% of US economic growth*

Real Gross Domestic Product
1950-2006

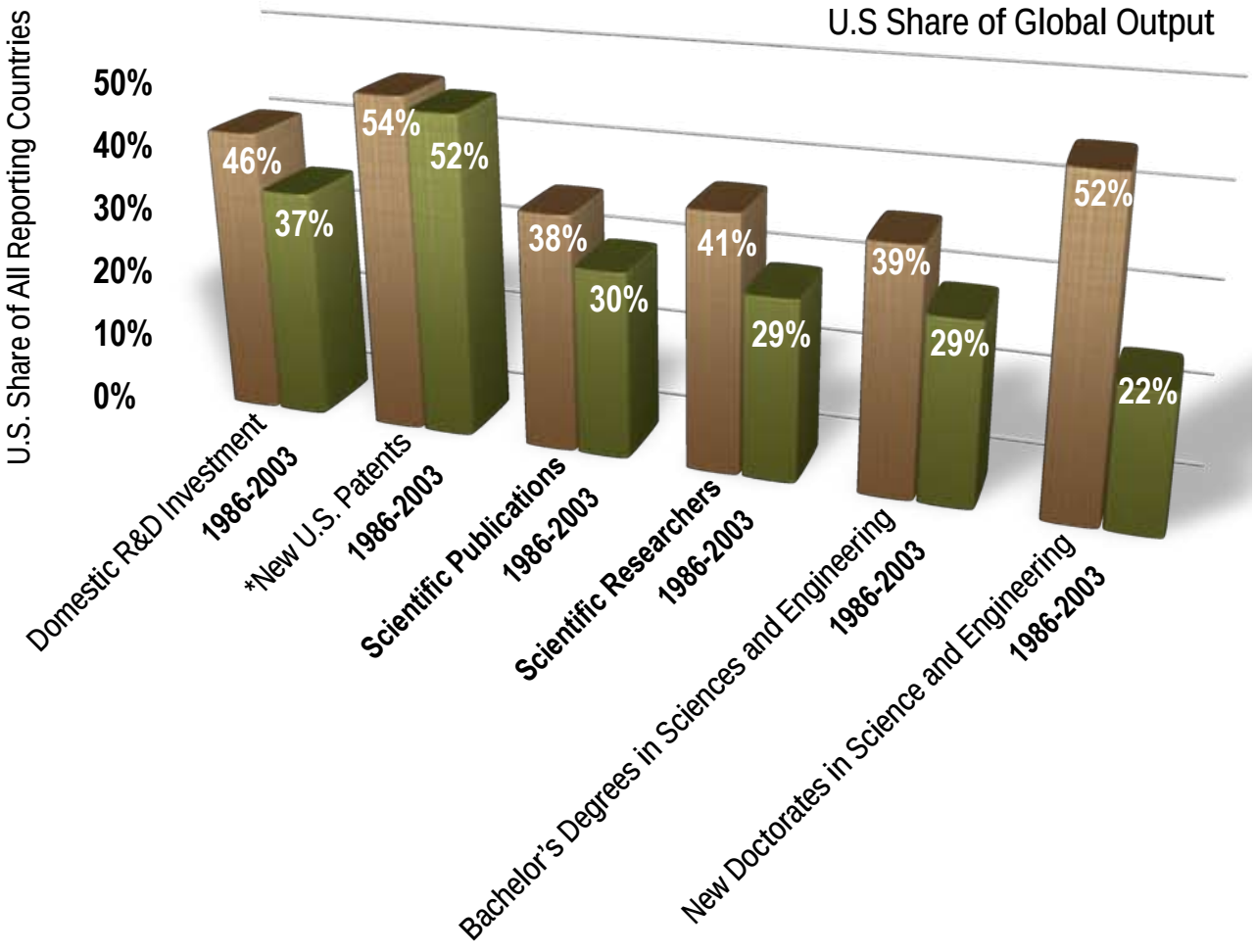


*For research supporting this chart, see Michael J. Boskin and Lawrence J. Lau. 1992. Capital, Technology, and Economic Growth. In Nathan Rosenberg, Ralph Landau, and David C. Mowery, eds. Technology and the Wealth of Nations: Stanford University Press. Stanford, CA

Source: Bureau of Economic Analysis, U.S. Department of Commerce.

Why METS and Innovation Matter for the U.S.

The U.S. global lead in science and technology is narrowing



* Countries from around the world register their patents in the U.S. because it is such a key market.

Source: Competitiveness Index: Where America Stands. Council on Competitiveness, 2006.

Why METS and Innovation Matter for the U.S.

Emerging economies have joined the high technology club

Top Ten High Tech Exporters (1986)	Top 10 High Tech Exporters (2005)
In billions of 1997 U.S. Dollars	
1. United States $65	1. China $406
2. Japan $53	2. United States $284
3. Germany $31	3. Japan $212
4. United Kingdom $24	4. Germany $$183
5. France $14	5. South Korea $167
6. Netherlands $9	6. Hong Kong $157
7. Italy $8	7. Taiwan
8. Switzerland $8	8. Singapore $126
9. Taiwan $7	9. Malaysia $99
10. South Korea $7	10. United Kingdom $95

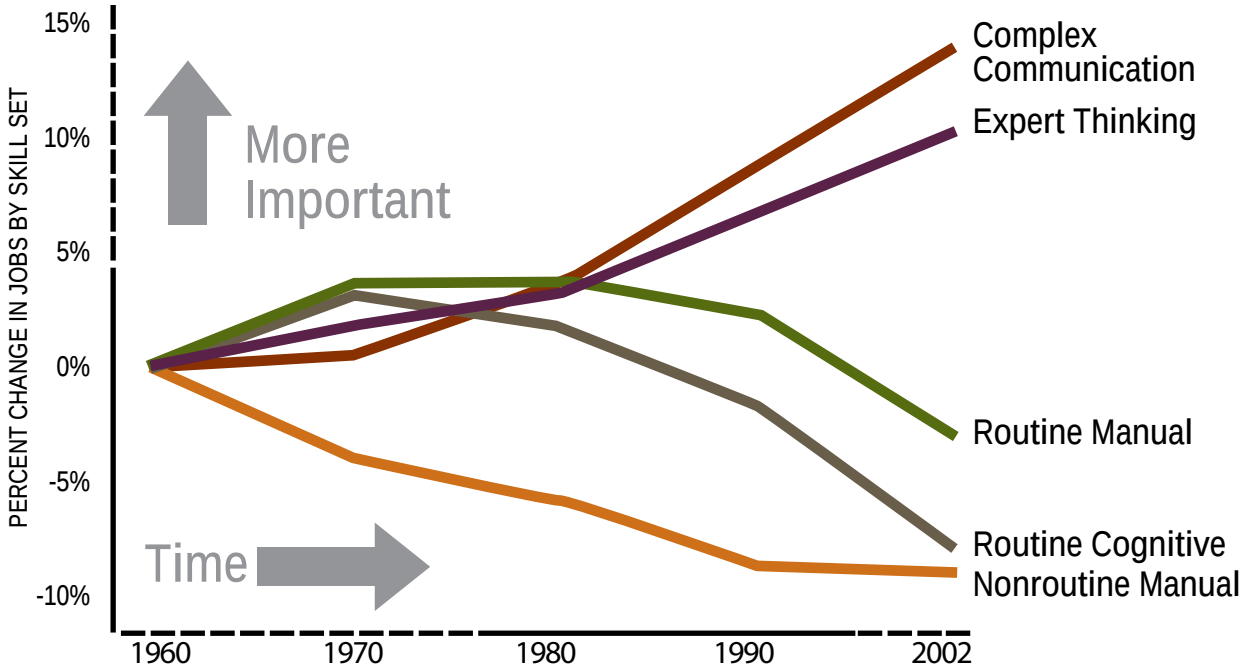
Emerging economies

Developed economies

Source: Competitiveness Index: Where America Stands. Council on Competitiveness, 2006.

Why METS and Innovation Matter for the U.S.

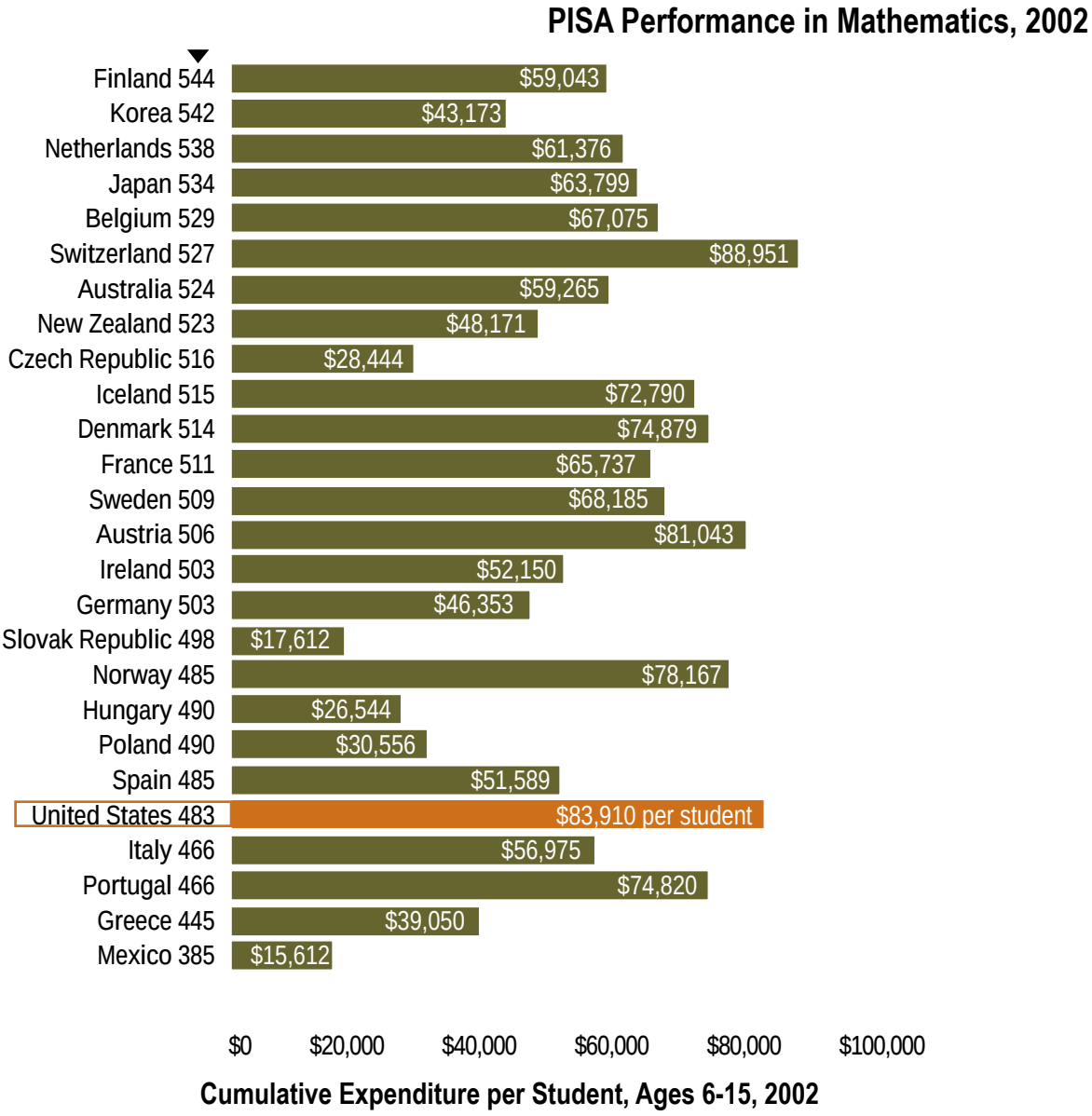
Innovation-based economies require higher skills



Source: Competitiveness Index: Where America Stands. Council on Competitiveness, 2006.

Why METS and Innovation Matter for the U.S.

The U.S. outspends others in K-12 education, but return on investment in math and science is low*



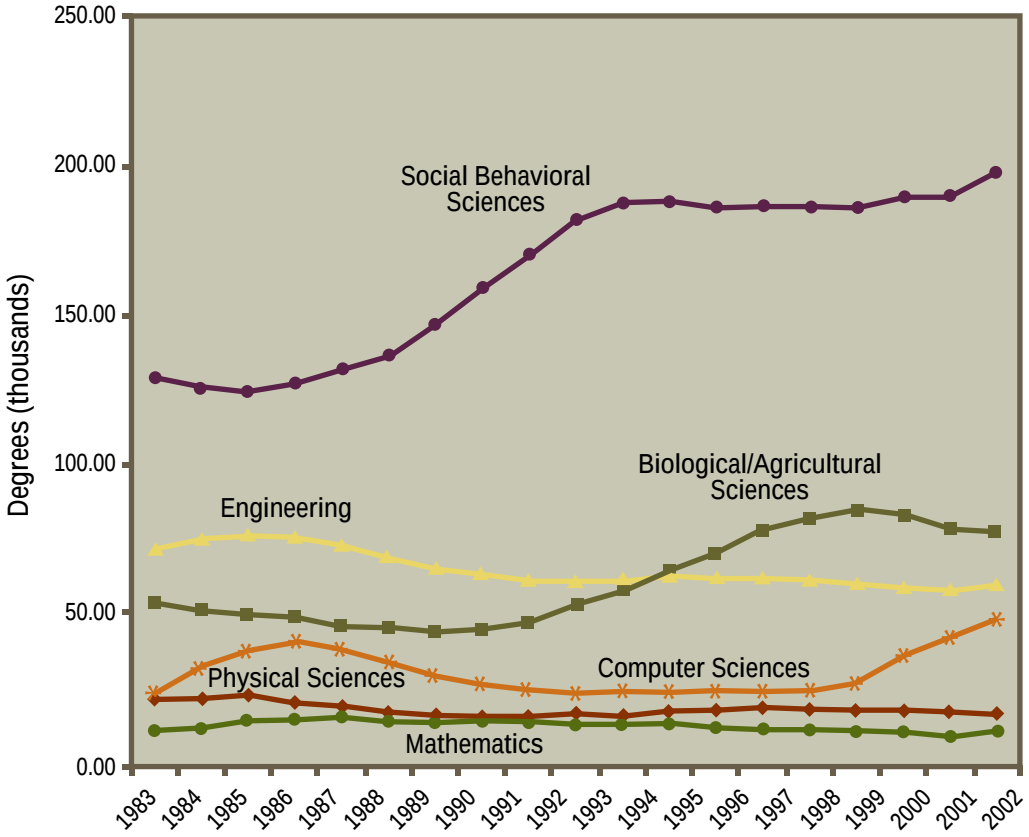
*The chart on this page summarizes the results of an international comparison of math proficiency of 15-year-olds sponsored by the Program for International Assessment (PISA) of the Paris-based Organization for Economic Cooperation and Development (OECD). Only member countries of the OECD participated in the assessment. The 2006 PISA assessments of math and science, released in December 2007 show comparable results.

Source: Competitiveness Index: Where America Stands. Council on Competitiveness, 2006.

Why METS and Innovation Matter for the U.S.

With few exceptions, US bachelor degree production in technical disciplines has remained flat or declining for the past two decades*

U.S. S&E Bachelor's Degrees by Field
1983 - 2002

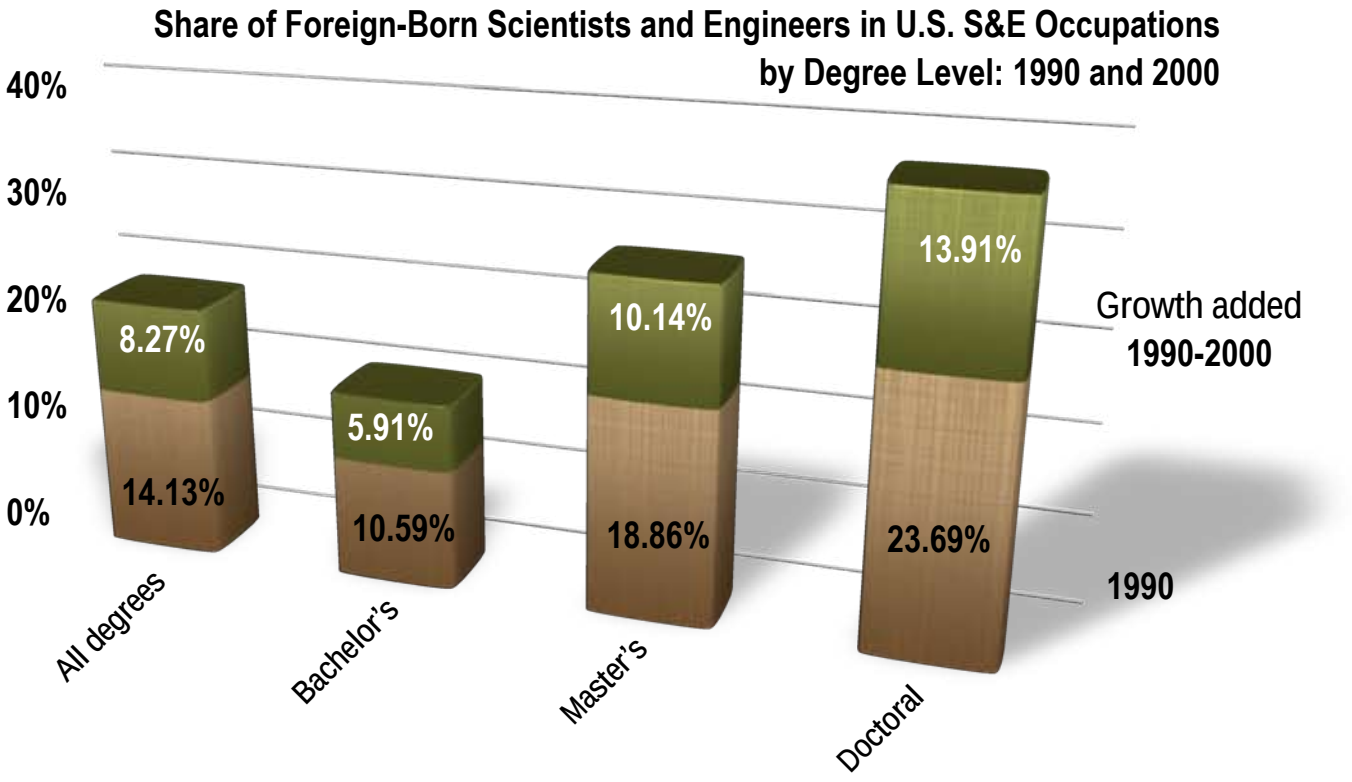


* The number of foreign-born students earning U.S. degrees increases significantly at the Master's and Doctoral level.

Source: NSF, Science and Economic Indicators, 2006.

Why METS and Innovation Matter for the U.S.

The U.S. is relying increasingly on foreign-born science and engineering professionals, even though opportunities are growing in their home countries



The Bottom Line

Americans will not continue to enjoy the world's highest standard of living without building capacity in METS

U.S. reliance on foreign-born technical talent is a natural result of globalization, but also a warning sign that home-grown does not measure up

Source: National Science Board, Science and Engineering Indicators, 2006.

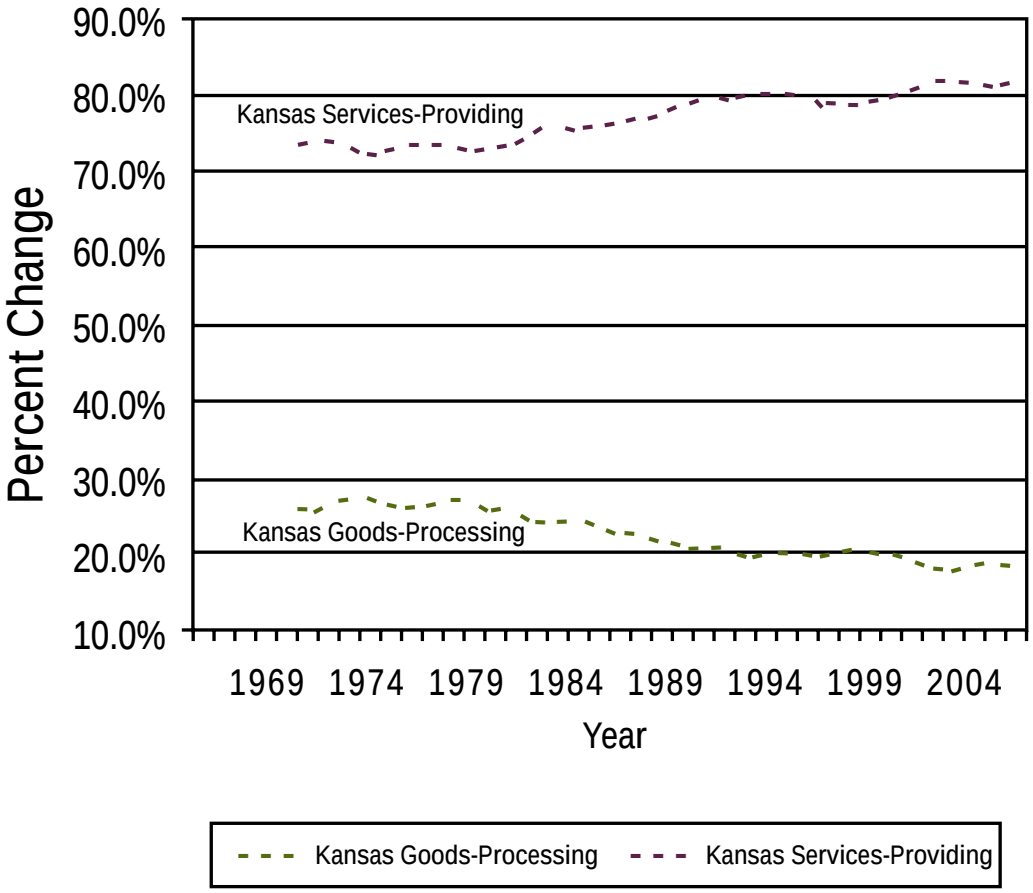
Section II: Why METS and Innovation Matter for Kansas

Although Kansas leads the world in production agriculture, the economy of the state is more di**verse and more service-oriented than many may realize**. The sectors that are most likely to generate significant numbers of high-wage jobs are knowledge-based. Most of these high-growth sectors are also intensely competitive. In order to create and maintain competitive advantage, Kansas must produce a deeper pool of technically skilled workers, while at the same time building capacity in frontier research and product development in selected fields. This section of the data book presents selected indicators highlighting why METS and innovation matter to Kansas.

Why METS and Innovation Matter for Kansas

Although Kansas is a world leader in production agriculture, service industries account for more than 80% of the state's Gross Domestic Product (GDP)*

Share of Goods-Producing and Service-Producing Industries
1970-2005



* Key service-producing industries include wholesale and retail trade, transportation, utilities, financial activities, professional and business services, education, health, leisure and hospitality, and government. Key good-producing industries include natural resources and mining, construction, durable goods manufacturing, (e.g., aviation) and non-durable goods manufacturing (e.g., food processing).

Source: Bureau of Labor Statistics, Labor Market Information Services, Kansas Department of Labor.

Why METS and Innovation Matter for Kansas

The manufacturing sector in Kansas is stronger than neighboring states and the U.S. economy as a whole*

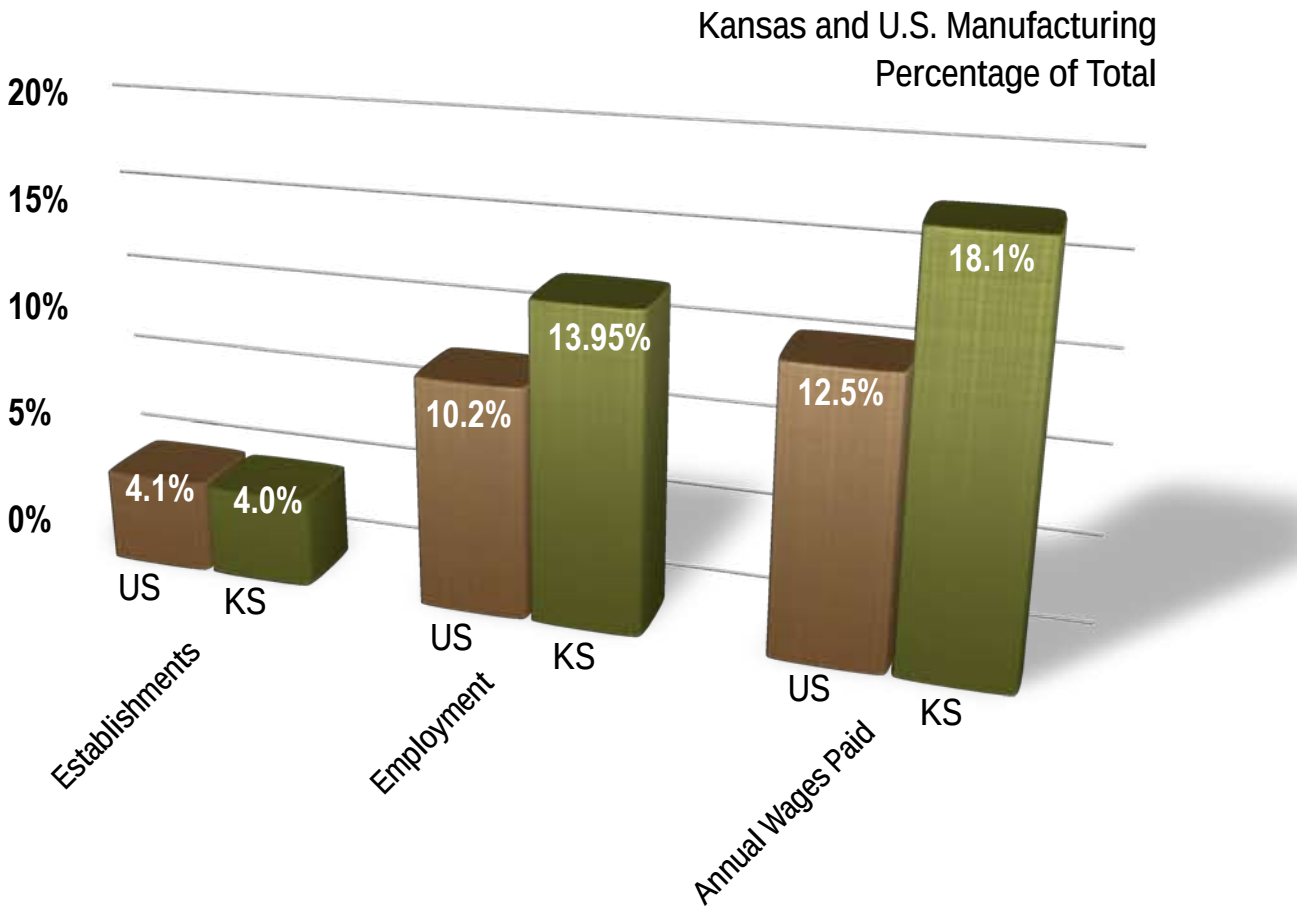
Manufacturing Employment							
All employees, thousands							
	Aug - 97	Aug - 02	Aug - 06	Aug - 07	1 - year change	5 - year change	10 - year change
Kansas	200	184.8	184.6	187	1.3%	1.2%	-6.5%
6-State Region	1,334.8	1,188.2	1,140	1,118.2	-1.9%	-5.9%	-16.2%
U.S.	17,552	15,272	14,303	14,098	-1.4&	-7.7%	-19.7%

* Whereas the national share of goods producing industries fell nearly 6 percent from 1990 to 2007, the Kansas share fell roughly 2 percent. This explains why the trend toward a service-driven economy is less pronounced in Kansas than the U.S. economy as a whole.

Source: Bureau of Labor Statistics, Labor Market Information Services, Kansas Department of Labor.

Why Math, Science and Innovation Matter to Kansas

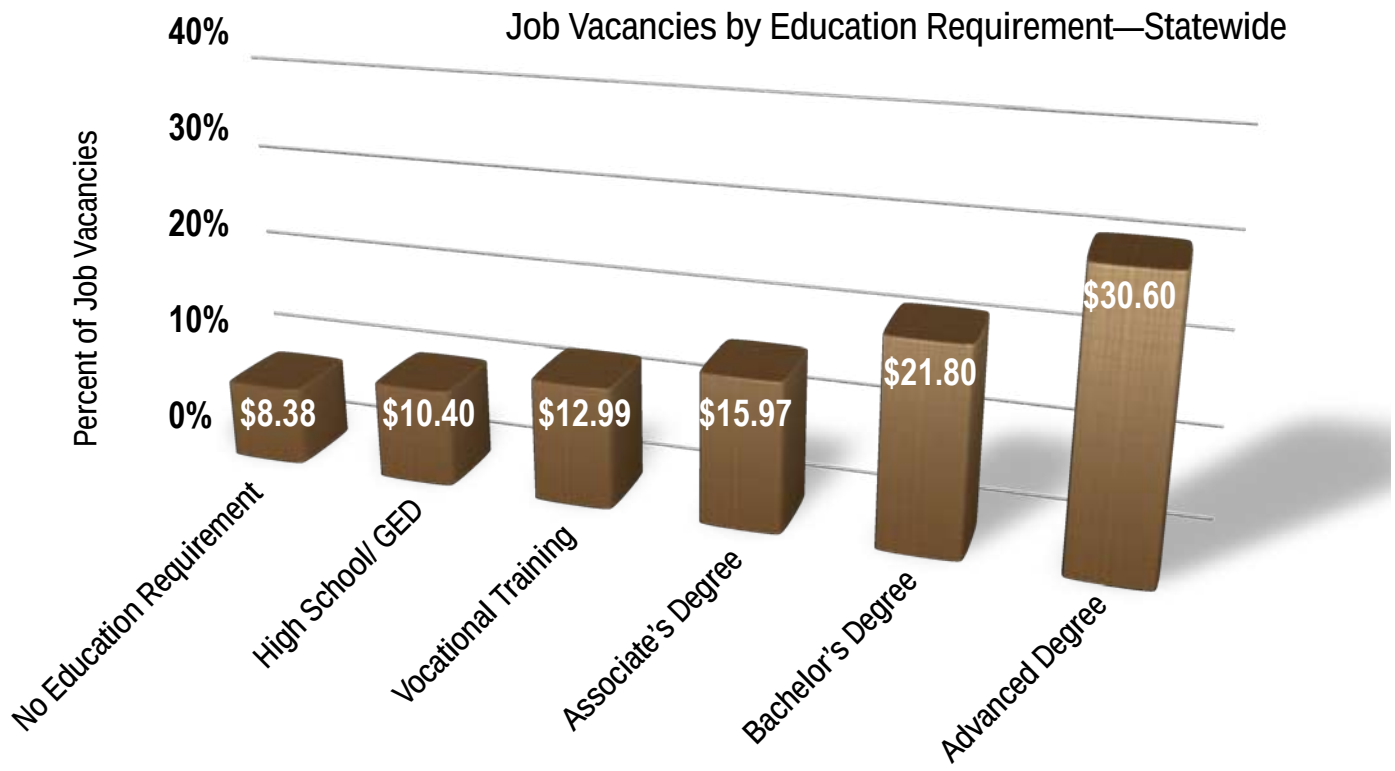
Manufacturing accounts for a larger share of employment and wages in Kansas than the U.S. economy as a whole



Source: Bureau of Labor Statistics, Labor Market Information Services, Kansas Department of Labor.

Why Math, Science and Innovation Matter to Kansas

More education commands higher-paying jobs in all economic sectors



Source: Kansas Department of Labor, Labor Market Information Services. Second Quarter 2007 Job Vacancy Survey.

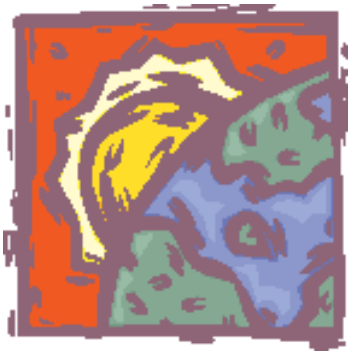
Why Math, Science and Innovation Matter to Kansas

A recent study by Kansas, Inc. identifies five high-growth industry clusters in which the state has the potential to create competitive advantage*

Bioscience[§]

Communications

Healthcare



Energy[χ]

Advanced Manufacturing/Aviation

[§] *Includes animal health*
[χ] *Includes bio-fuels*

* A February 2007 competitive benchmarking of the Kansas economy by the Monitor Group and the National Governors' Association Center for Best Practices reaches roughly the same conclusions, while also drawing a distinction between industry clusters that are exposed to national and international competition ("traded clusters") and those that are not ("local clusters"). Crop agriculture and food processing are defined in the Monitor-NGA benchmarking report as traded clusters, as are the five clusters called out in the Kansas, Inc. study.

Source: Positioning Kansas for Competitive Advantage: Aligning Key Industry Clusters and Occupations with Postsecondary Education and Workforce Development. Kansas, Inc. 2007. "A Competitive Benchmarking of the Kansas Economy," Monitor Group and NGA Center for Best Practices, February 2007.

Why Math, Science and Innovation Matter to Kansas

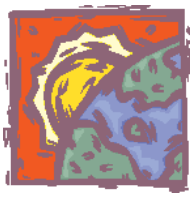
These high-value sectors will generate growing demand for highly-skilled workers

Bioscience

- R&D in physical, engineering, and life sciences
- Animal Health
- Pharmacology
- Clinical testing
- Manufacturing
- Software development and application
- Management and sales

Communications

- R&D in new products, methods of transmission, and services
- Systems engineering
- Systems software
- Network and computer administration
- Business operations



Energy

- R&D in bio-fuels and other renewable resources
- Cost analysis
- Information systems support
- Production
- Maintenance
- Transportation

Advanced Manufacturing/Aviation

- R&D in new materials, electronics, information systems
- Production and installation
- Maintenance
- Supply Chain Management
- Transportation
- Business and Finance

Health Care

- R&D in devices, genetics, nanotechnology, and robotics
- Diagnostics
- Health information
- Medical services (physicians, nurses, therapists)
- Clinical and dental technology
- Management

Source: The 2007 State New Economy Index: Benchmarking Economic Transformation in the States, The Information Technology and Innovation Foundation and Ewing Marion Kauffman Foundation.

Why Math, Science and Innovation Matter to Kansas

The educational attainment of the Kansas workforce is slightly above the national average

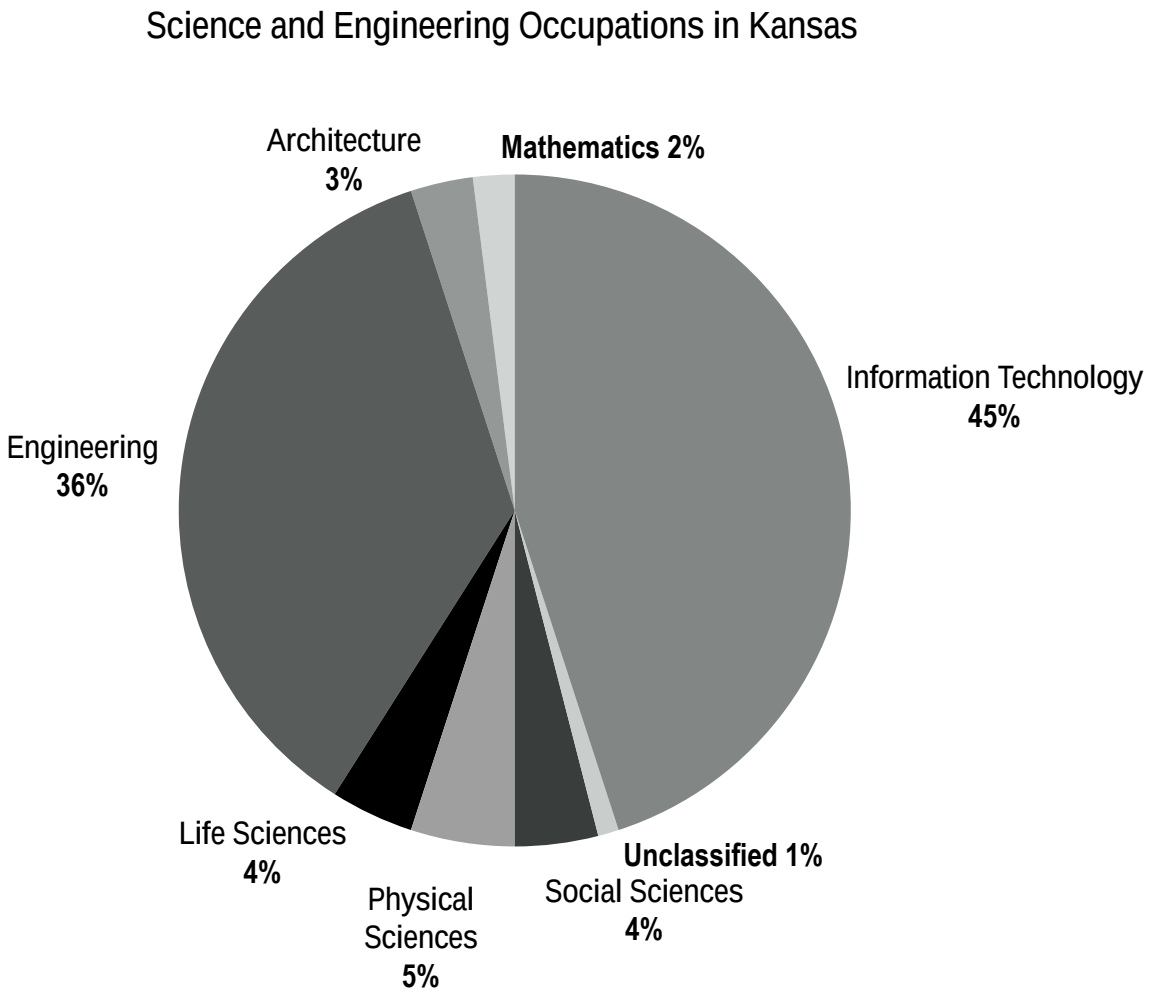
State Ranking by Educational Attainment		
State	Rank	Score (Weighted **Average***)
Massachusetts	1	52.4
Colorado	2	50.0
Kansas	19	**40.8**
Nebraska	21	40.1
Iowa	36	35.2
Missouri	38	35.9
Arkansas	49	28.7
US Average		*39.7*

* A weighted average of advanced degrees, bachelor's degrees, associate's degrees, and some college coursework.

Source: State "New Economy" Index.

Why Math, Science and Innovation Matter to Kansas

Information technology and engineering loom large in the state's technical workforce of baccalaureate and advanced degree holders



Source: 2007 Population Reference Bureau.

Why Math, Science and Innovation Matter to Kansas

Kansas ranks above average in meeting its own needs in computer science and especially in engineering

In-State Degree Production in Selected Tech Fields (by 1,000 jobs, 2005)					
National Ranking		Bachelor's Degrees Awarded **per 1,000** Tech Jobs	Change **from 2001 to 2005**	Degrees Awarded	Tech Jobs in Selected Fields
Engineering Bachelors	14	69.5	25.7%	697	10,034
Engineering Tech Bachelors	24	72.6	6.7%	466	6,422
Computer Science Bachelors	16	47.3	9.3%	475	10,040
Computer Science Associates	42	18.2	-2.0%	193	10,620

Source: NCEMS Information Center for State Higher Education Policy Making and Analysis, www.higheredinfo.com.

Why Math, Science and Innovation Matter to Kansas

Nevertheless, almost one out of every three reported employment vacancies requires post-secondary education

All Job Vacancies	Number of Job Vacancies	Percent of All Job Vacancies	Average Minimum Wage Offer	Average Maximum Wage Offer
All Job Vacancies	*52,229*	*100*	*$11.97*	*$13.80*
No Education Requirement	14,132	27	$8.38	$9.70
High School or GED	19,692	38	$10.40	$11.87
→ Vocational Training	4,438	9	$12.99	$16.10
→ Associate's Degree	2,715	5	$15.97	$18.06
→ Bachelor's Degree	6,904	13	$21.80	$25.05
→ Advanced Degree	1,234	2	$30.60	$33.69
No response	3,114	6	$11.53	$13.26

* Percentages may not add up due to rounding.

Source: Kansas Department of Labor, Labor Market Information Services. Second Quarter 2007 Job Vacancy Survey.

Why Math, Science and Innovation Matter to Kansas

Employer surveys and gap analysis also indicate long-term shortfalls in job categories requiring post-secondary education in technical fields*

Projected Occupational Shortages
Accounting
Agriculture
Aviation
Engineering
Information-Technology
Nursing
Protective Services
Skilled Trades
Teachers of Math and Science*

* K-12 teachers of math and science did not fall within the purview of the 2007 cluster study, but the shortages estimated in this data book prompted the Legislature's Advisory Committee to include this occupation.

Source: Positioning Kansas for Competitive Advantage: Aligning Key Industry Clusters and Occupations with Postsecondary Education and Workforce Development. Kansas, Inc. 2007.

Why Math, Science and Innovation Matter to Kansas

Historically, Kansas has been less competitive than most states in winning federal research awards

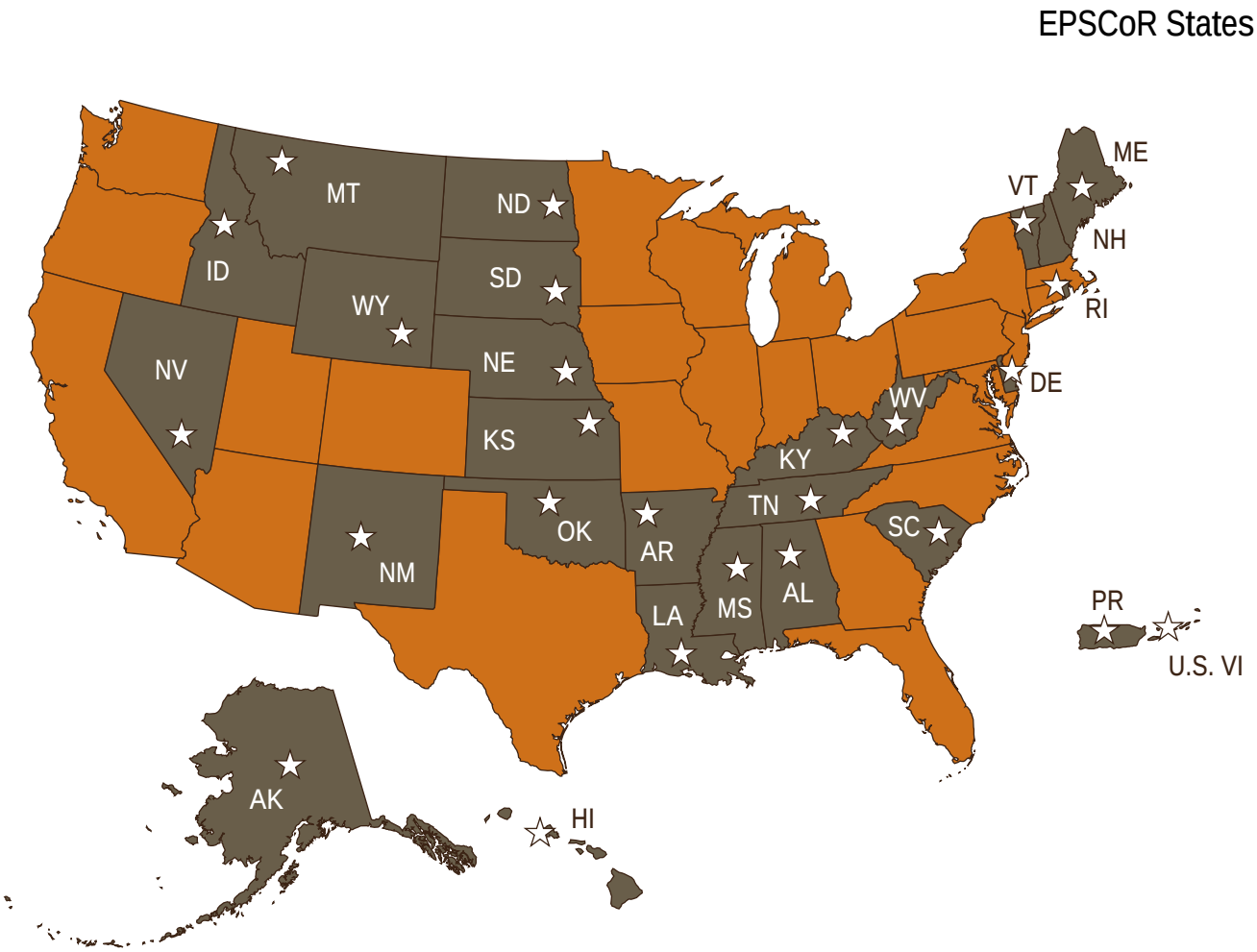
Federal Grants to Kansas **FY 2002**					
Agency	Total	Industrial Firms	Universities & Colleges	Other **Non-Profits**	Rank
All agencies	290,516	21,030	17,154	106,164	38
Dept. Agriculture	16,907	0	8,118	0	36
Dept. Commerce	835	835	0	0	45
Dept. Defense	17,941	8,887	5,150	0	45
Dept. Energy	8,193	462	7,731	0	34
Dept. HHS	207,653	3,415	69,907	105,159	27
Dept. Interior	2,940	2	556	0	37
Dept. Transportation	9,444	4,448	3,200	0	18
EPA	459	0	208	126	43
NASA	4,311	1,190	2,242	879	44
NSF	21,833	1,791	20,042	0	32
Rank	**38**	**43**	**35**	**13**	na

Note: Federal R&D obligations are as reported by funding agencies. Ranks and totals are based on data for 50 states, District of Columbia and Puerto Rico.

Source: National Science Foundation/Division of Science Resources Statistics.

Why Math, Science and Innovation Matter to Kansas

As a result, Kansas is one of 24 states qualifying for federal support under the Experimental Program to Stimulate Competitive Research (EPSCoR)



Source: National Science Foundation.

Why Math, Science and Innovation Matter to Kansas

The state also lags in key "new economy" indicators including entrepreneurial activity, initial public offerings, fast-growing firms and inventor patents*

New Economy Indicators		
State	Rank	Score
Utah	1	13.78
Colorado	3	13.23
Arkansas	25	9.16
Missouri	37	7.30
Kansas	45	**6.11**
Iowa	48	5.59
US Average		*10*

* Kansas has taken action to strengthen the state's "new economy" assets through the 2004 Kansas Economic Growth Act, a key component of which included the establishment of a Bioscience Authority to attract world-class talent and guide cutting-edge investments.

The Bottom Line

Kansas' economic future depends on deepening its pool of technical talent.

The state is not producing sufficient technical talent to meet near-term needs and capitalize on long-term opportunities.

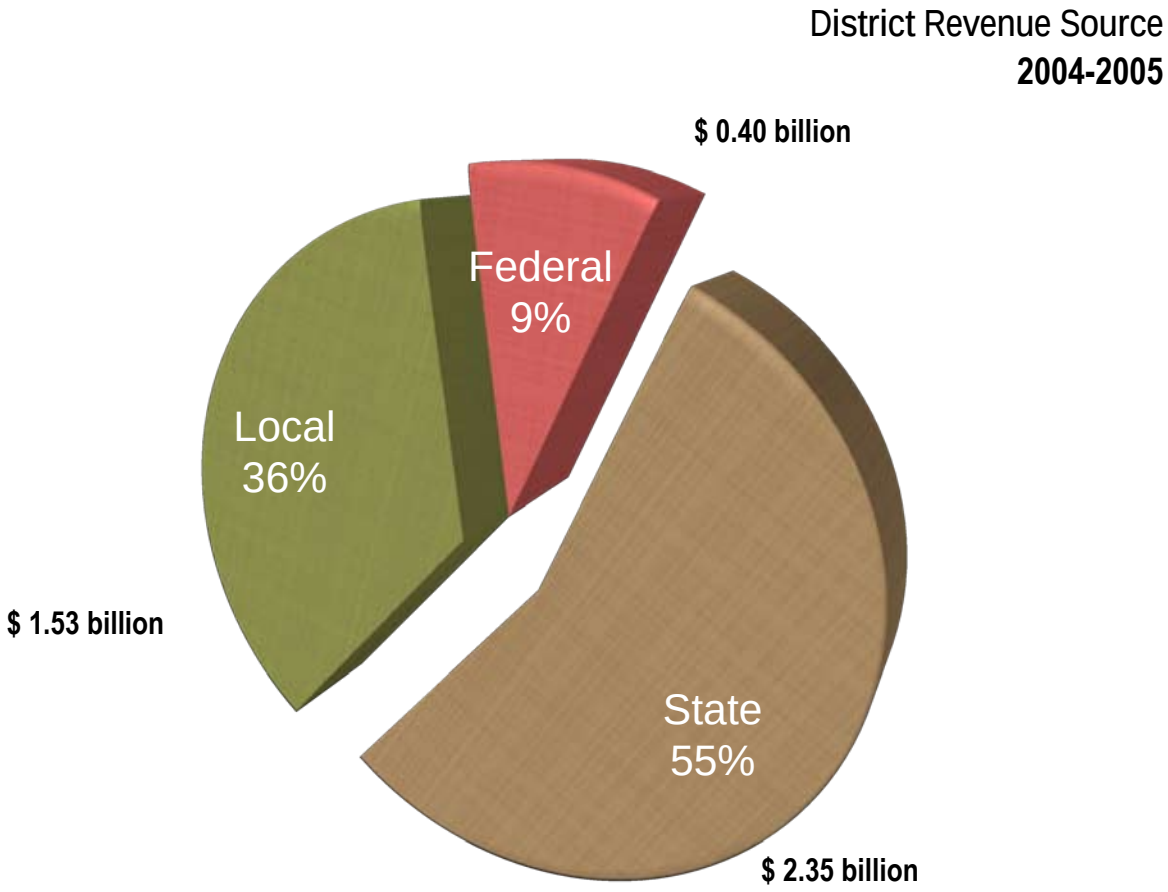
Source: The 2007 State New Economy Index: Benchmarking Economic Transformation in the States, The Information Technology and Innovation Foundation and Ewing Marion Kauffman Foundation.

Section III: K-12 Indicators

K-12 math and science education in Kansas is shaped by the interplay of federal, state, and local decisions. The federal No Child Left Behind Act sets national achievement goals and holds schools accountable for annual progress toward reaching them. The State Board of Education determines what students are expected to learn at each grade level and what qualifications teachers of math and science must hold. The state also develops and administers tests to measure student proficiency. Two hundred ninety-six local school districts, varying widely in size, enrollment, and resources, have the last word on matters of governance, curriculum, and teacher hiring. This section of the data book highlights the performance of Kansas' K-12 enterprise in equipping students with foundational skills in math and science.

K-12 Indicators

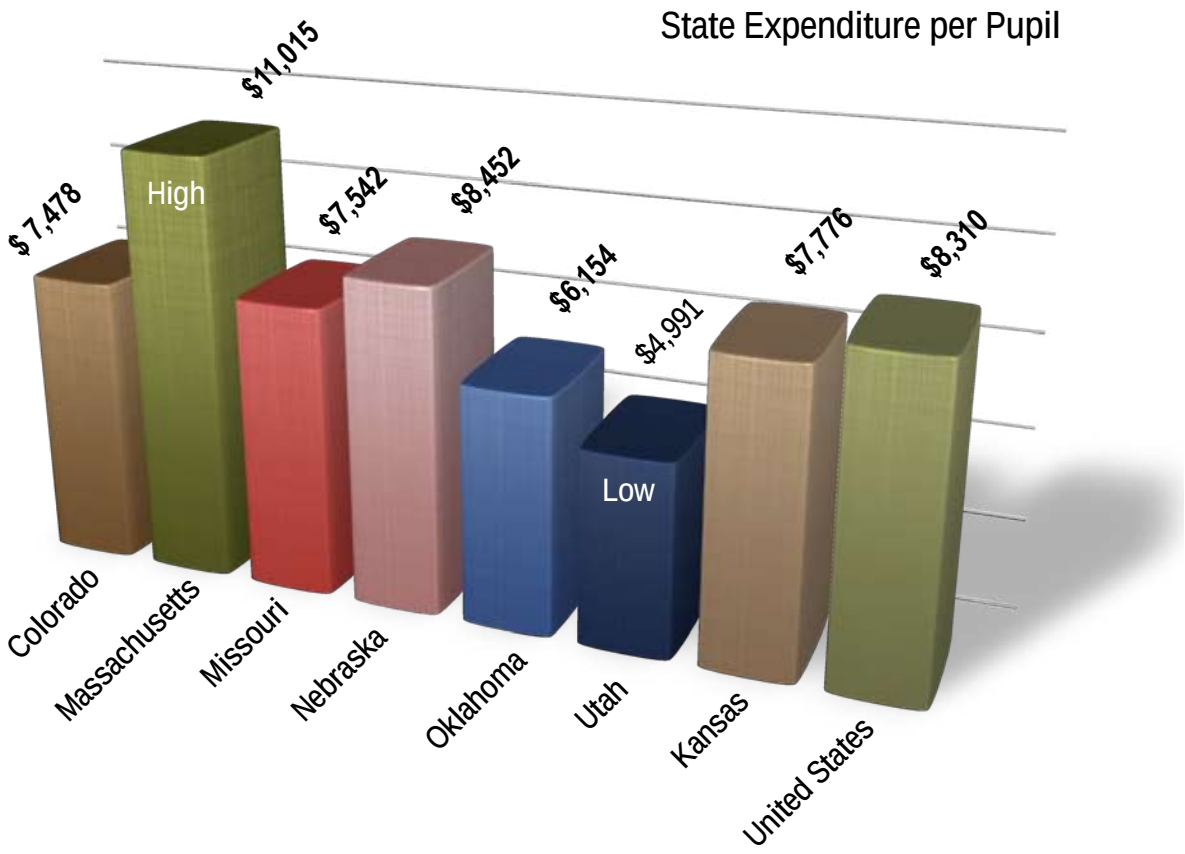
Kansas' $4 billion K-12 enterprise draws upon federal, state, and local resources



Source: U.S. Department of Education, National Center for Education Studies.

K-12 Indicators

Kansas K-12 spending per pupil is not as high as most states



Source: National Center for Education Statistics: Digest of Education Statistics 2006.

K-12 Indicators

The student population of about 465,000 is less diverse than the U.S. as a whole, but the pace of recent change has been dramatic

Racial/Ethnic Composition of Students		
	Kansas	National
White	73.4	59.2
African-American	8.4	17.7
American Indian	1.4	1.2
Asian	2.3	4.4
Two or more races	2.6	-
Hispanic	11.8	18.1

Recent Changes in Kansas K-12 Enrollment by Race and Sex

				White		Black		Hispanic		Amer. Ind./Alaska		Asian/Pac Is.	
	Total	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1999	469,205	242,149	227,056	193,538	180,949	20,949	19,998	19,808	18,375	2,941	2,836	4,910	4,896
2006	465,135	240,147	224,988	174,394	162,306	18,724	17,652	28,743	27,159	3,277	3,134	5,405	5,436

Source: Kansas Department of Education.

K-12 Indicators

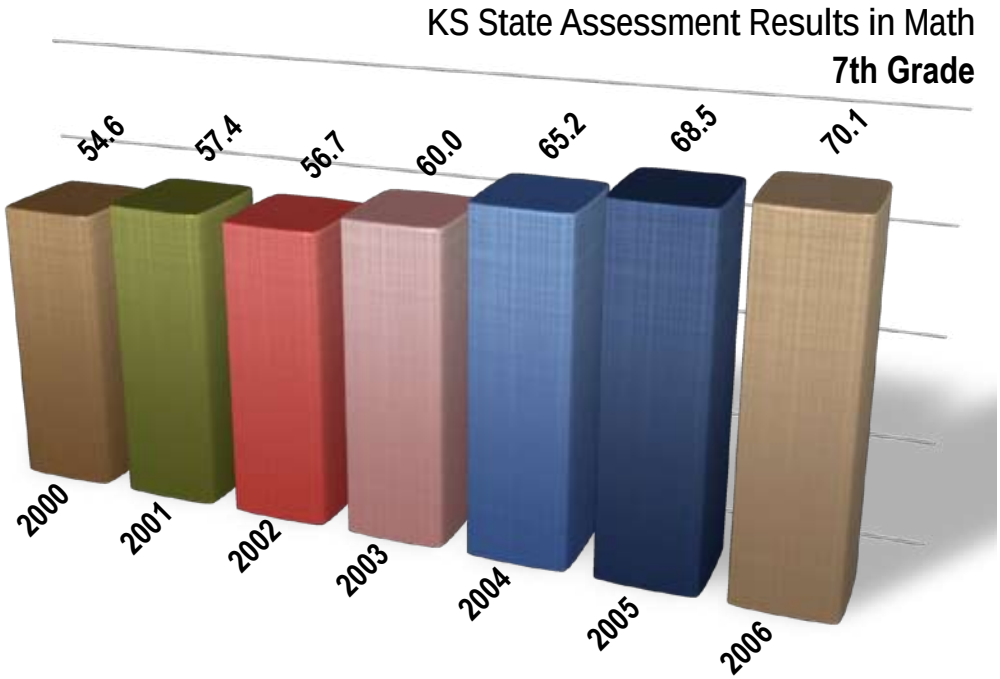
Steady enrollments have produced about 30,000 high school graduates per year

High School Graduates	
2005-06	29,836
2004-05	30,192
2003-04	30,123
2002-03	29,930
2001-02	29,510

Source: Kansas Department of Education.

K-12 Indicators

State math assessments show impressive gains since 2000 as well as 2006 achievement levels exceeding performance targets in all grades

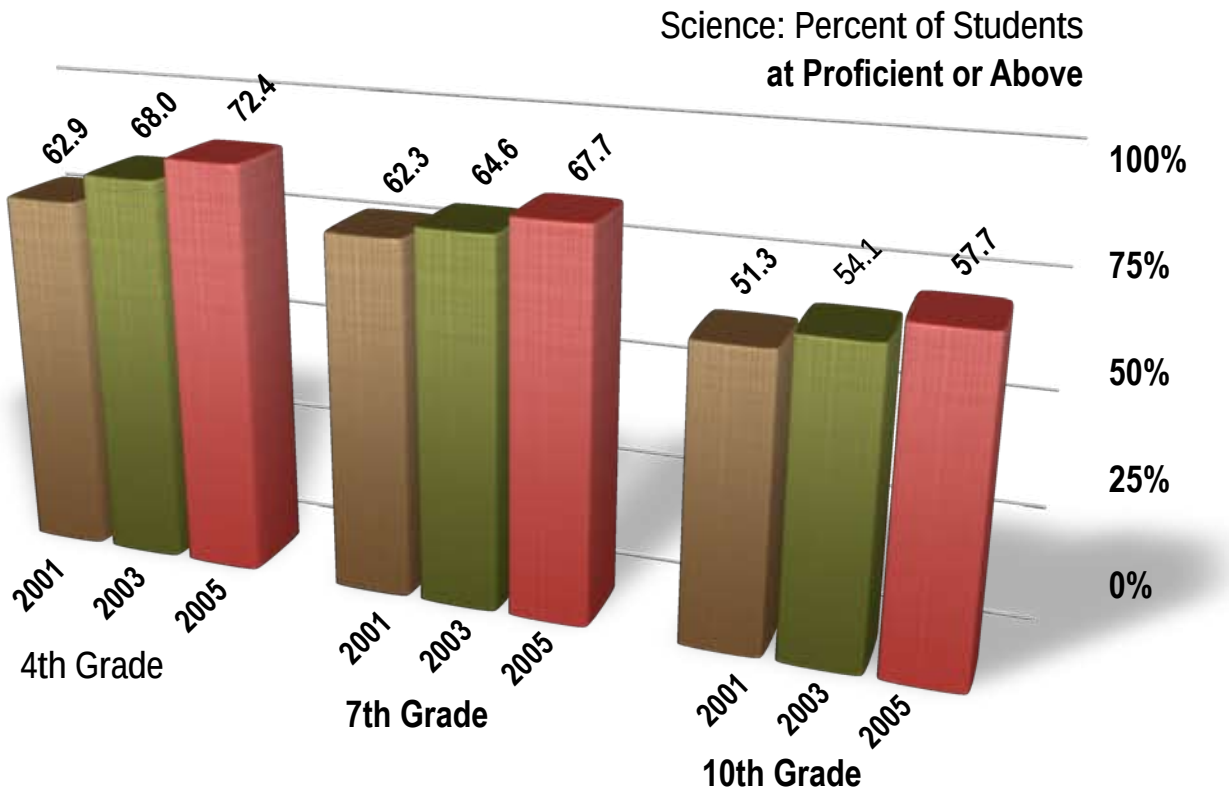


Kansas State Assessment Results: Math			
State	Grade	Score	No Child Left Behind Target Score
Student achievement in the top three performance categories remain strong: - meets standard - exceeds standard - exemplary	3	80.9	66.8
	4	80.7	66.8
	5	78.8	66.8
	7	74.3	66.8
	7	70.1	66.8
	8	66.6	66.8
	HS	58.3	55.7

Source: Kansas Department of Education.

K-12 Indicators

State science assessments also show gains in achievement

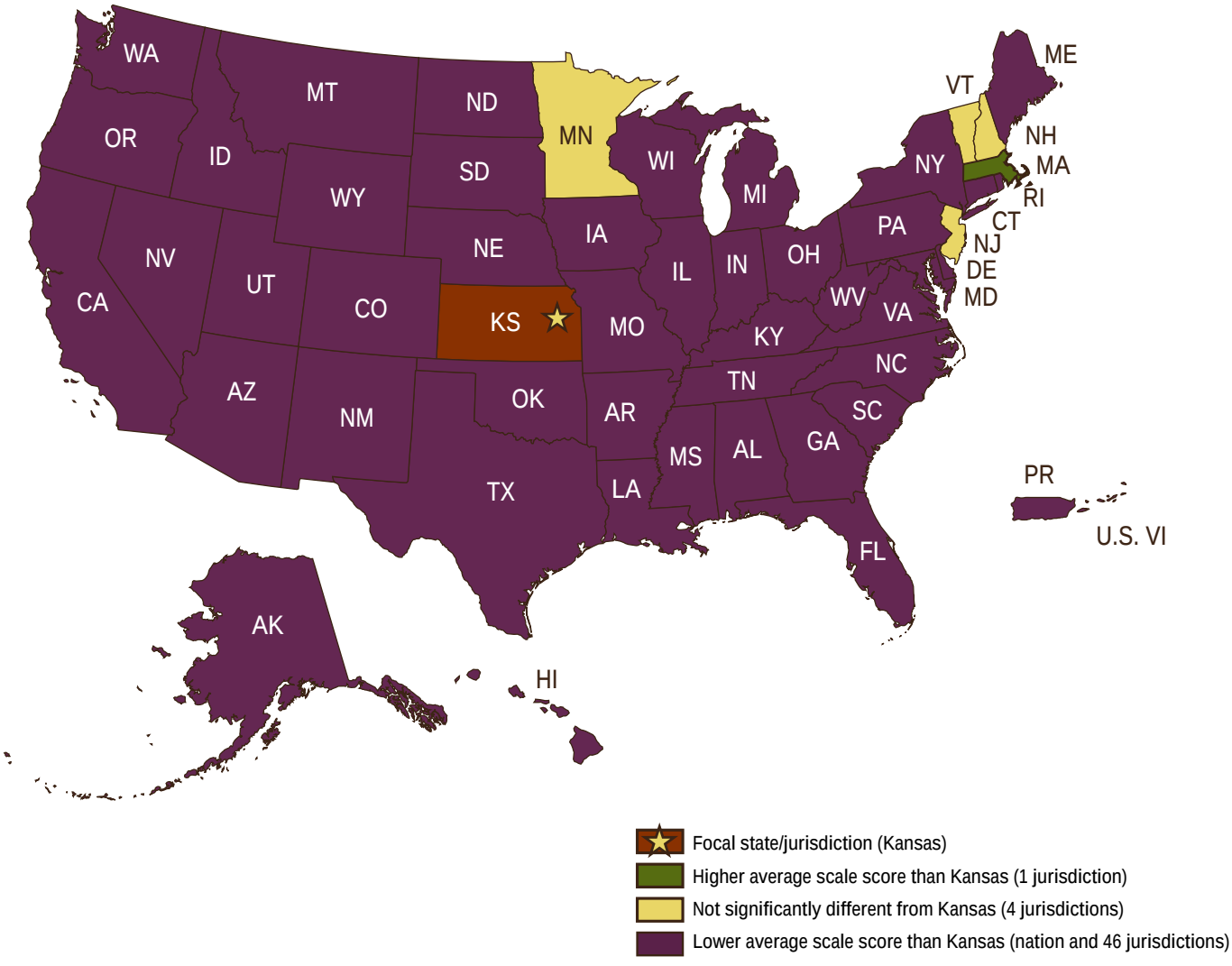


Source: Kansas Department of Education.

K-12 Indicators

National 4th grade math assessments confirm that Kansas is a high-performing state

Kansas Scores in Comparison with NAEP, 4th Grade

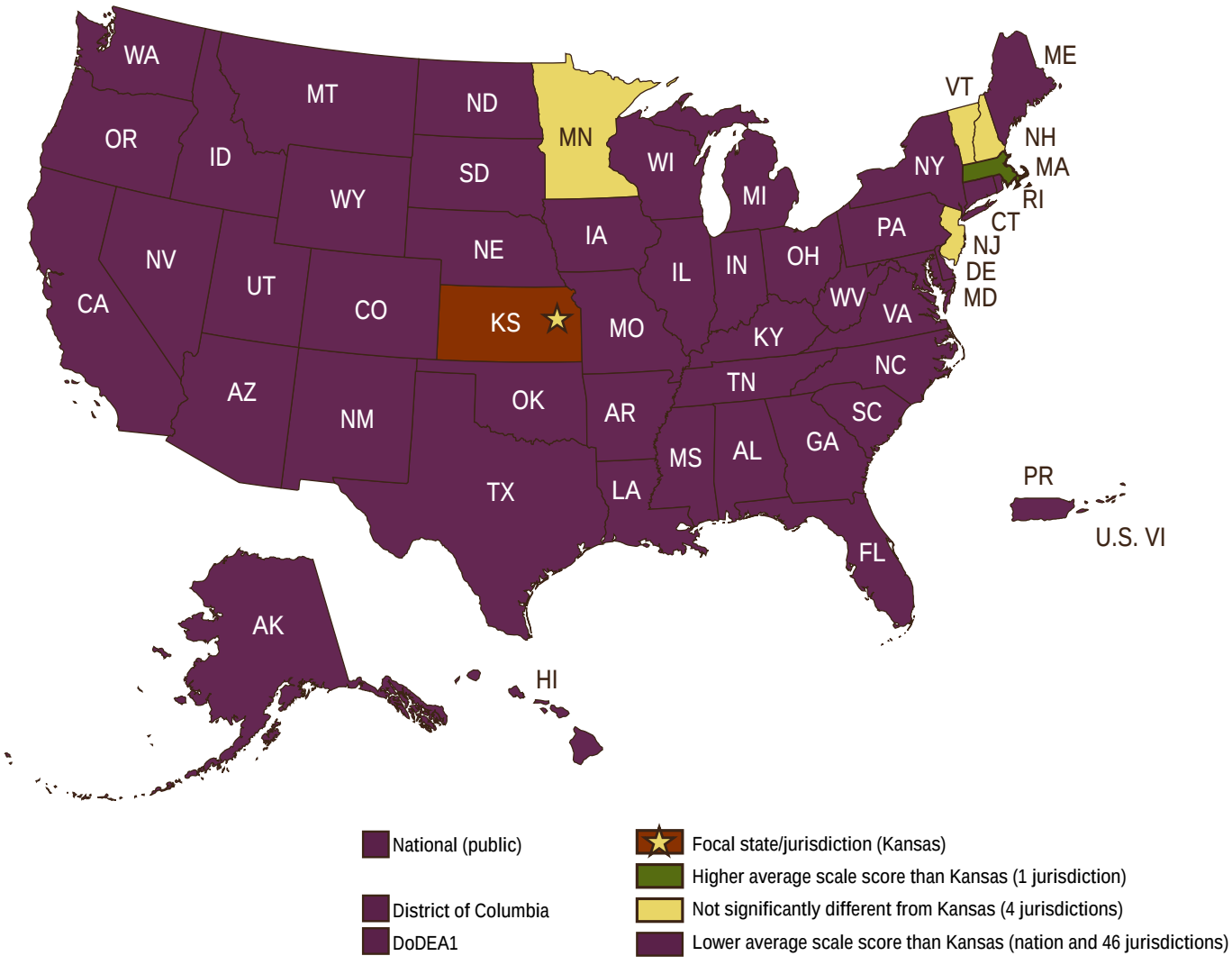


Source: U.S. Dept. of Education, Institute of Education Sciences/National Assessment of Education Progress (NAEP) 2007.

K-12 Indicators

National 8th grade assessments also show high relative performance

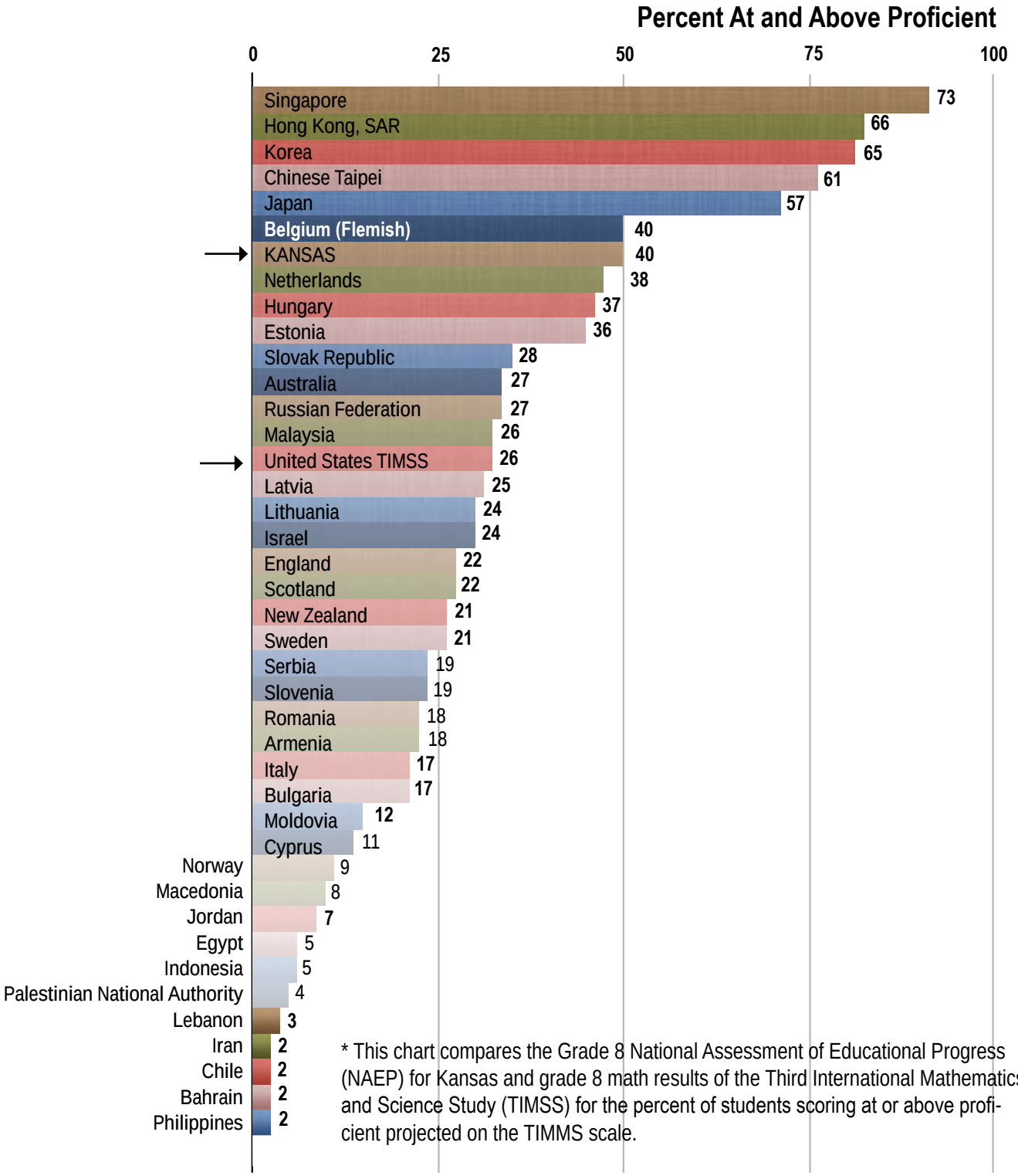
Kansas Scores in Comparison with NAEP, 8th Grade



Source: U.S. Dept. of Education, Institute of Education Sciences/National Assessment of Education Progress (NAEP) 2007.

K-12 Indicators

Math achievement in Kansas compares favorably with many countries, but significantly lags the highest-achieving countries*



* This chart compares the Grade 8 National Assessment of Educational Progress (NAEP) for Kansas and grade 8 math results of the Third International Mathematics and Science Study (TIMSS) for the percent of students scoring at or above proficient projected on the TIMMS scale.

Source: Phillips, Gary W., Chance Favors the Prepared Mind: Mathematics and Science Indicators For Comparing States and Nations, AIR: Wash., DC, 2007. Kansas did not participate in the grade 8 state NAEP in science.

K-12 Indicators

Despite comparatively high achievement in math, about half the Kansas student sample taking the national assessment scores below grade level*

Proficiency of Kansas Students in Math					
		Below Basic	Basic	**Proficient**	Advanced
		Percentage at Grade Level			
Grade 4	2000	24	47	26	2
	2003	15	44	36	6
	2005	12	41	39	8
	2007	11	38	42	9
Grade 8	2000	24	43	29	5
	2003	24	42	28	6
	2005	23	42	29	5
	2007	19	41	32	9

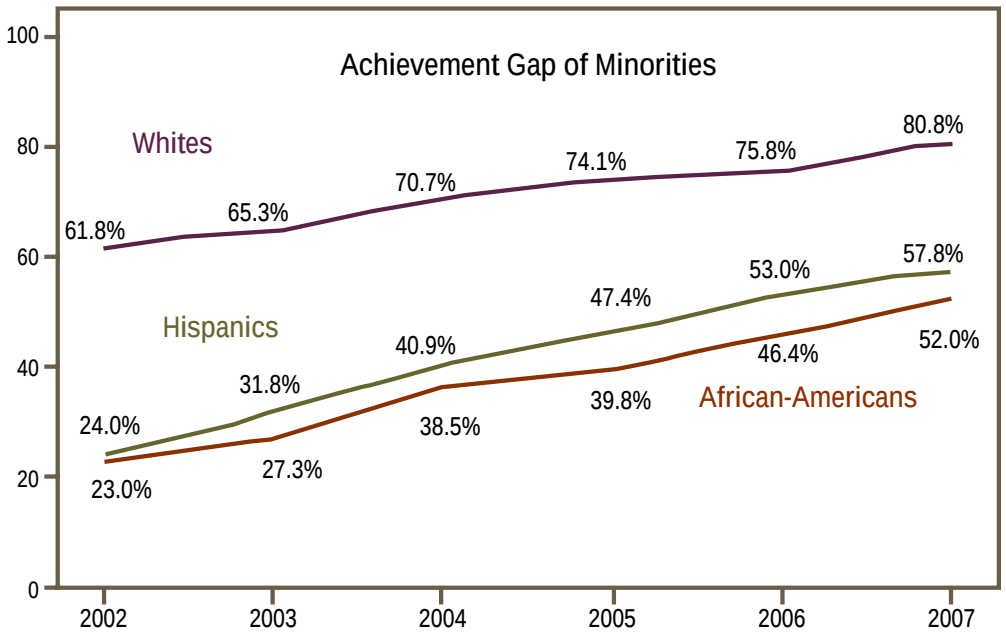
* Grade level is the equivalent of "proficient."

Source: U.S. Department of Education, National Assessment of Educational Progress (NAEP).

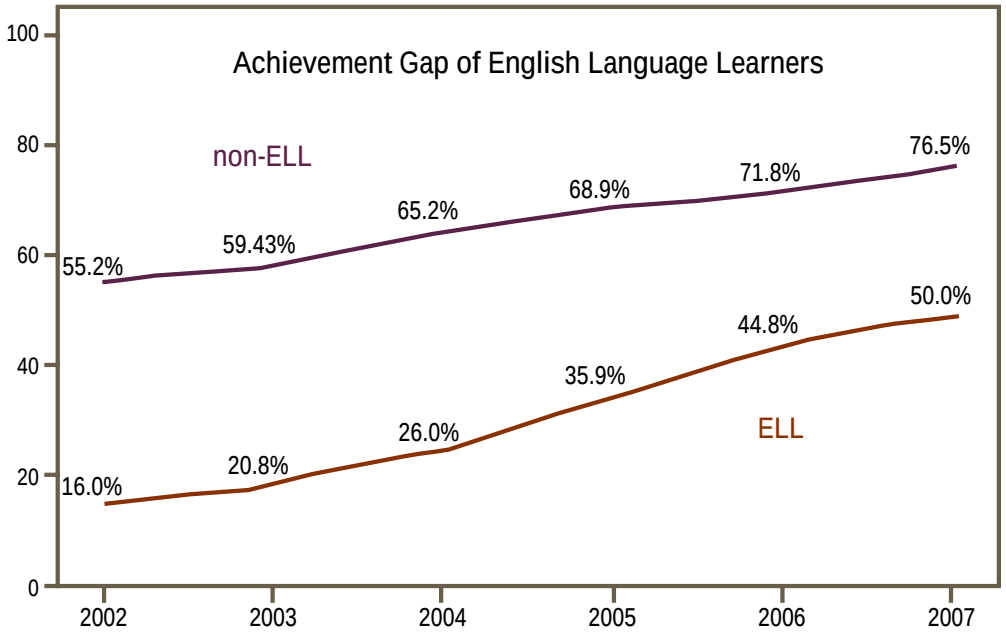
K-12 Indicators

Despite gains across all groups, achievement varies widely among income level, race and ethnicity, language status, and special learning needs.

Kansas 7th Grade Mathematics Trends, % at Standard or Above



Kansas 7th Grade Mathematics Trends, % at Standard or Above



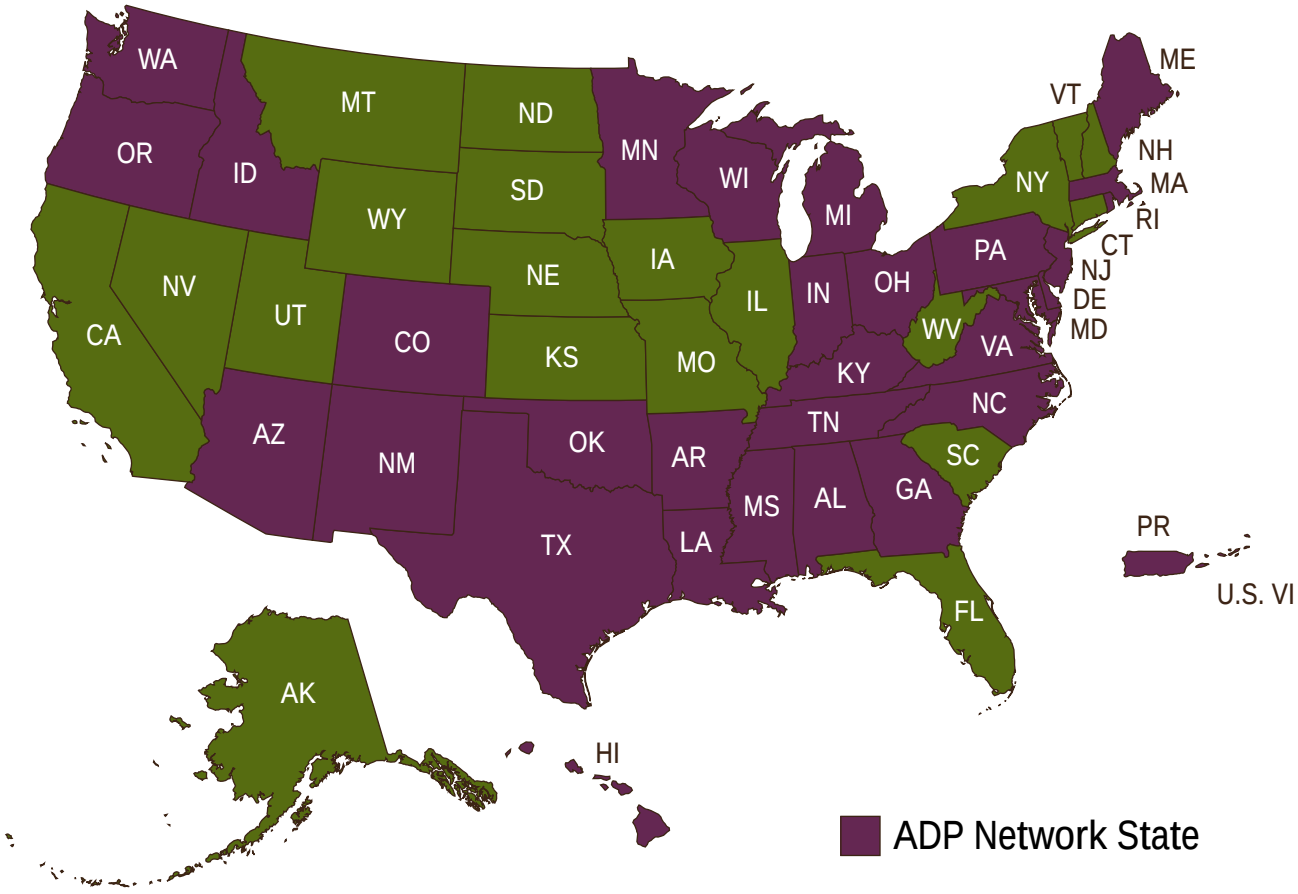
Source: Kansas State Department of Education.

K-12 Indicators

Math course requirements are on par with many states, but not among the most rigorous

High School Math Course Requirements	
Kansas	3 units including Algebra I and geometry concepts
Guidelines for 30 state members of American Diploma Project Network	4 units, including the content equivalent of Algebra I and II, geometry, and statistics or pre-calculus

Member States of the American Diploma Project Network



Source: American Diploma Project, www.achieve.org.

K-12 Indicators

Kansas science course requirements are not among the most rigorous

High School Science Course Requirements	
Kansas	3 approved units Including chemistry or physics and one lab course
National	35 states require (or are phasing in) three or more units of science. 17 states require (or plan to require) at least two lab sciences. Georgia, Indiana and West Virginia require explicit lab-based science

Source: Education Commission of the States, State Notes Mathematics/Science June 2007.

K-12 Indicators

Science assessments mandated under No Child Left Behind will begin in 2007-2008, but will be less frequent and less high stakes than those mandated for math

High School Science Course Requirements	
Math	Science
Tests administered annually in every grade span 3-8 and at least once in grade span 10-12	Tests administered at least once annually in grade spans 3-4, 6-9, 10-12
Results Factor in school accountability	Results Do not factor in school accountability

K-12 Indicators

Kansas high school students take the ACT college admission test at comparable rates to most surrounding states and score above the national average in math and science

2007 ACT-Tested High School Graduates	
State	Percent of Graduates Tested
Arkansas	75
Colorado	100 (required)
Iowa	66
Kansas	**76**
Missouri	74
Nebraska	77
Oklahoma	71
National	**42***

Five-Year Trends - Average ACT Scores						
	Number of Students Tested		Average ACT Scores			
			Mathematics		Science	
Grad Year	State	National	State	National	State	National
2003	23,813	1,175,059	21.2	20.6	21.5	20.8
2004	23,472	1,171,460	21.1	20.7	21.5	20.9
2005	23,106	1,186,251	21.2	20.7	21.6	20.9
2006	23,056	1,206,455	21.3	20.8	21.6	20.9
2007	23,196	1,300,599	21.4	21.0	21.7	21.0

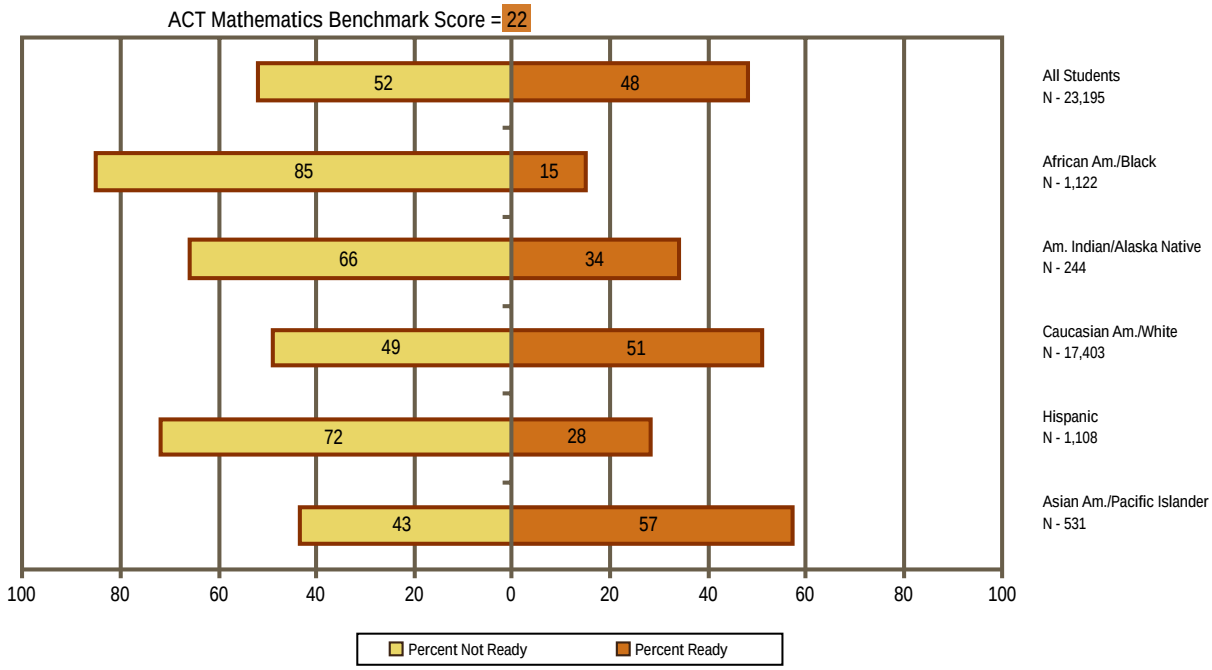
** The Scholastic Aptitude test (SAT) of the College Board is used in many high-population states outside the Midwest.*

Source: ACT High School Profile Report: The Graduating Class of 2007/Kansas www.act.org/news/data/07/pdf/states/Kansas.pdf.

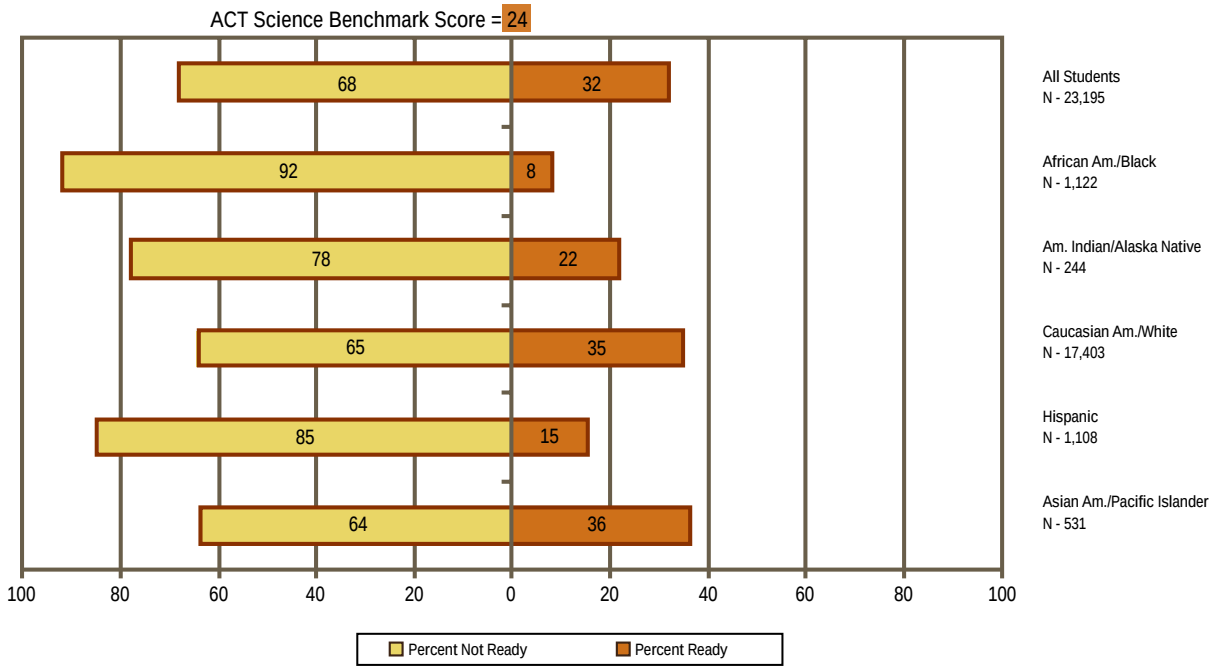
K-12 Indicators

However, only about half of ACT test takers are deemed college ready in math and only about one-third are college ready in science

Percent of Students Meeting ACT College Readiness Benchmark Scores by Race/Ethnicity: Mathematics



Percent of Students Meeting ACT College Readiness Benchmark Scores by Race/Ethnicity: Science

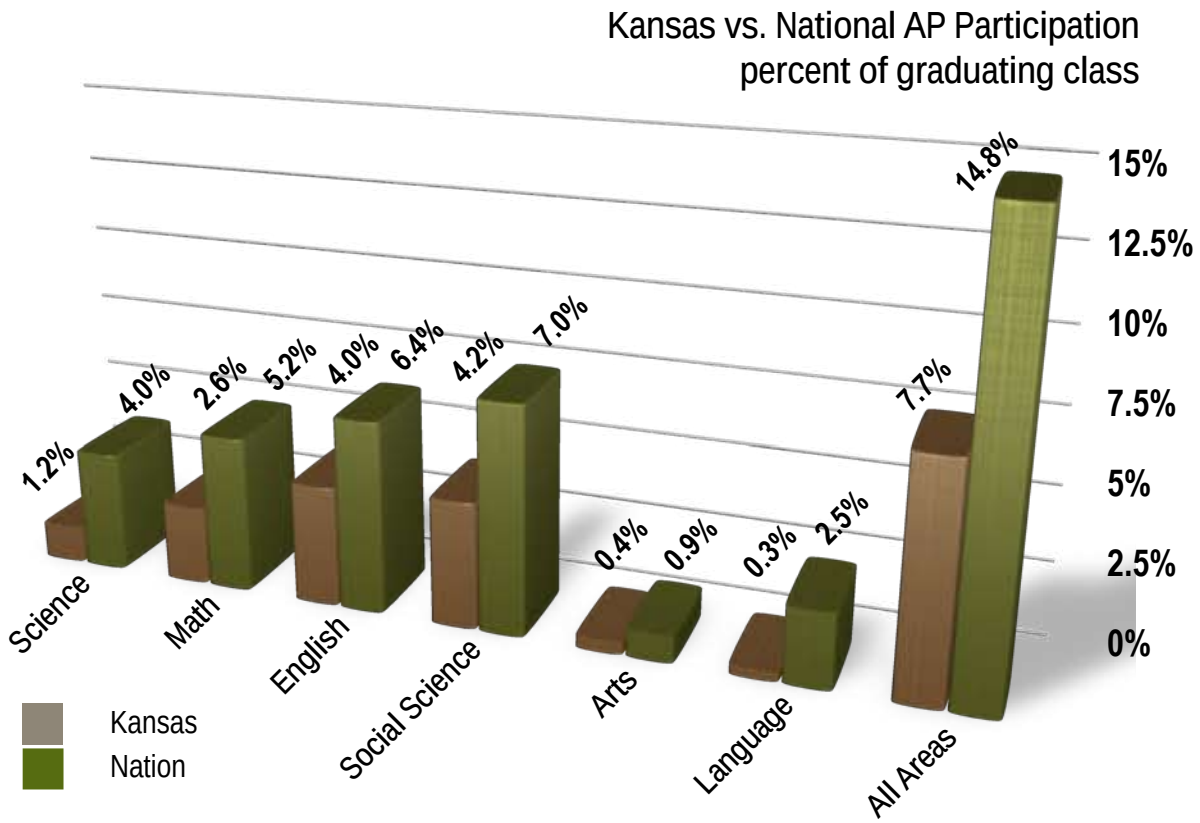


Source: ACT Kansas Profile 2007.

K-12 Indicators

Concurrent enrollment in Kansas provides readily available college opportunities, limiting participation in nationally benchmarked Advanced Placement courses

Concurrent Enrollment in Kansas	
Vocational Tech	2,080
Community College	5,564
State University	341
Private College	370
Total	8,355

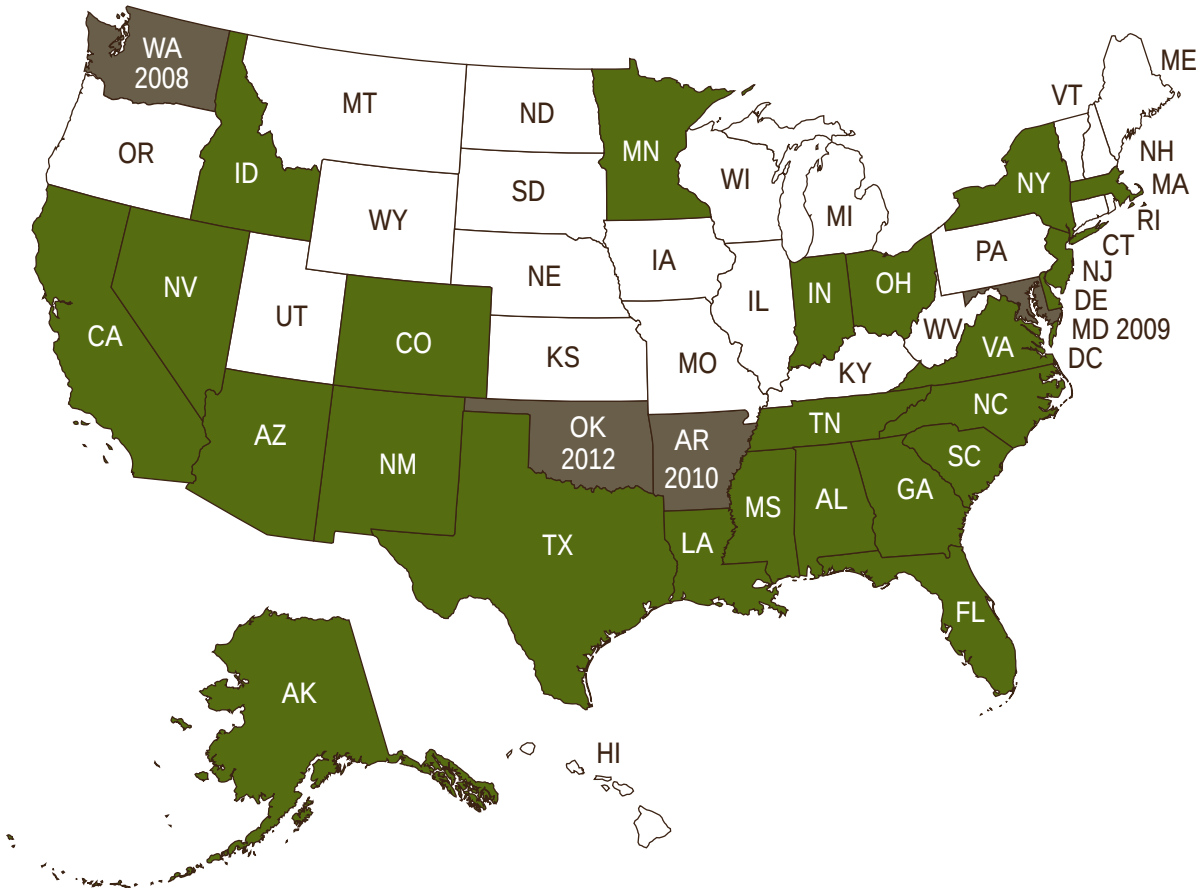


Source: AP Report to the Nation 2007 Kansas State Report.

K-12 Indicators

Kansas does not use a high school exit exam to establish an achievement "floor" in math

States with Mandatory Exit Exams (2007)



States with mandatory exit exams in 2007:
AL, AK, AZ, CA, FL, GA, ID, IN, LA, MA, MN, MS, NV, NJ, NM, NY, NC, OH, SC, TN, TX, VA
(22 states)

States phasing in exit exams by 2012 but not yet withholding diplomas:
AR (2010), MD (2009), OK (2012), WA (2008)
(4 states)

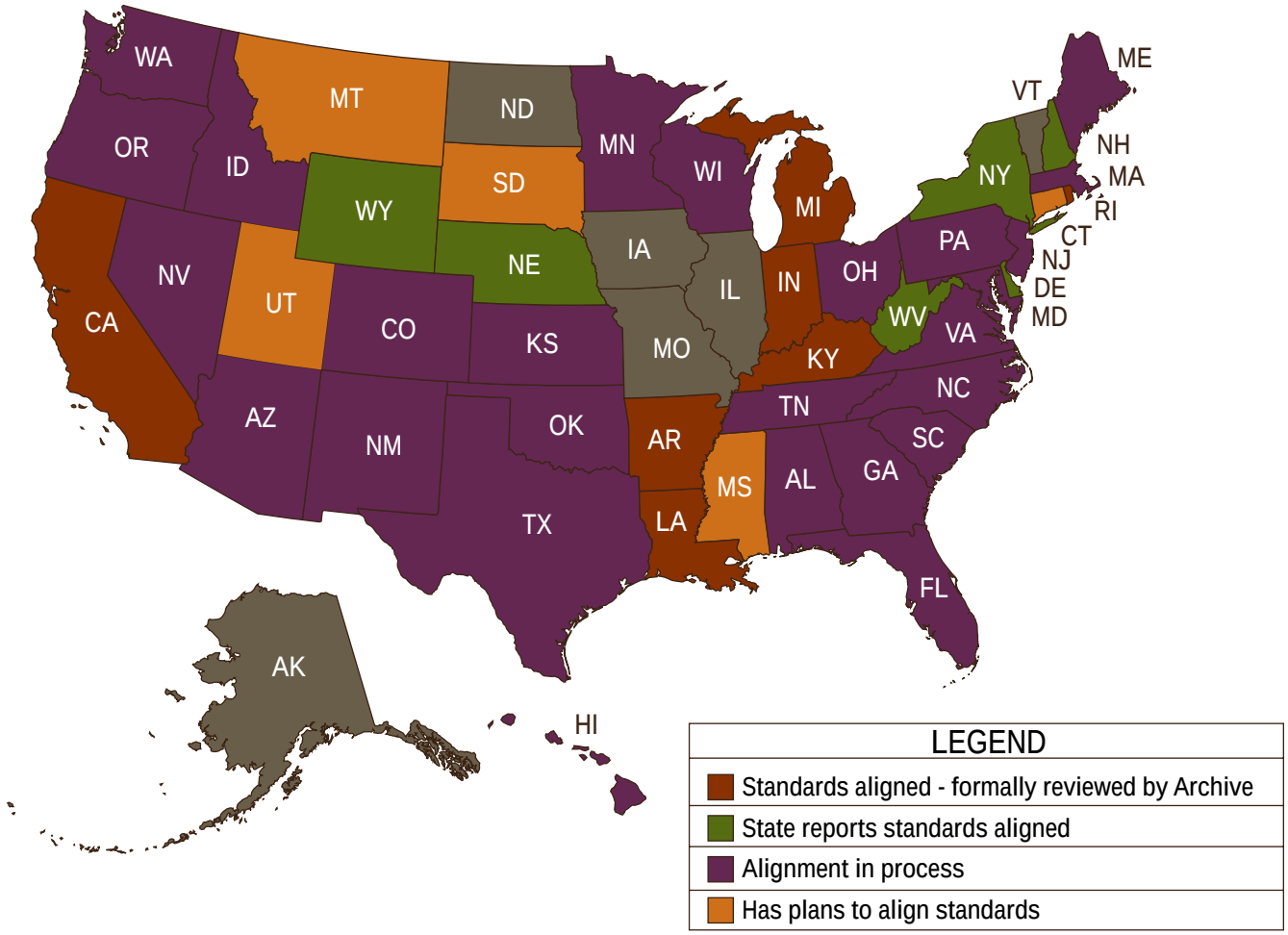
States with no mandatory exit exam:
CO, CT, DE, DC, HI, IL, IA, KS, KY, ME, MI, MO, MT, NE, NH, ND, OR, PA, RI, SD, UT, VT, WV, WI, WY
(24 states and DC)

Source: Center on Education Policy, exit exam survey of state departments of education, June 2007.

K-12 Indicators

Kansas is putting in place an integrated K-20 data system and Council, but has not yet made as comprehensive an effort as some states to align K-12 and post-secondary education

States that Align Standards

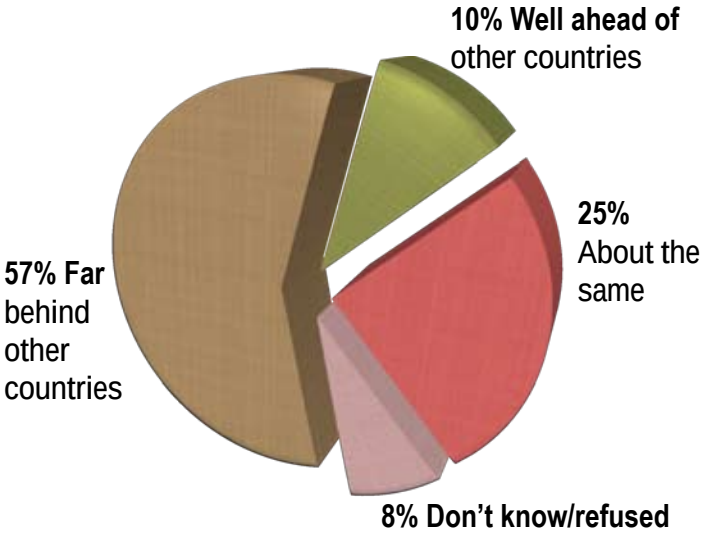


Source: www.achieve.org.

K-12 Indicators

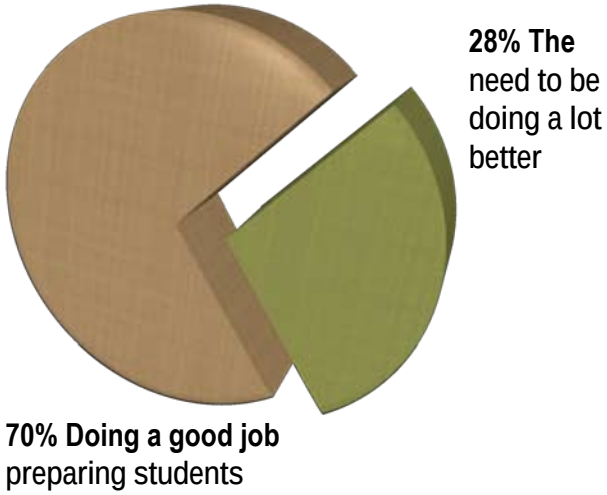
Parents in Kansas recognize the importance of METS, but are much less concerned than employers about the quality of math and science education in local schools

Is the U.S. Competitive in METS?



Most parents recognize that the United States is behind other countries in math, science and technology education.

How Does METS Education in Kansas Rate?



But unlike local leaders, they are confident that local schools are doing a good job preparing students for the future.

The Bottom Line

Despite Kansas' high achievement in math and science, a significant minority achievement gap persists and half the state's graduates are not ready for college-level work in these disciplines

Kansas has an opportunity to collaborate productively with other states in meeting METS challenges

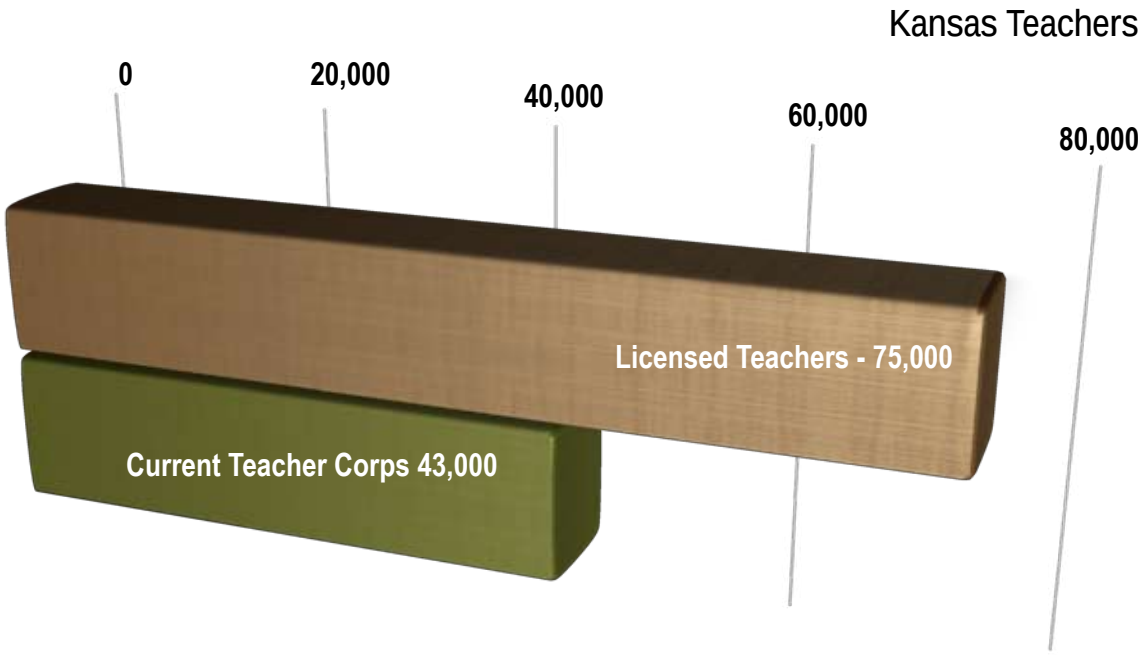
Source: "Important, But Not for Me; Kansas and Missouri Students and Parents Talk about Math, Science and Technology Education." Public Agenda 2007.

Section IV: K-12 Math-Science Teacher Corps

Decades of research indicate that teachers play a critical role in math and science education. Although the teaching profession has had historic appeal in Kansas, a number of factors have converged in recent years to put the math and science teacher corps under increasing pressure. These include the high-stakes testing and accountability provisions of No Child Left Behind, the influx of English language learners, the aging of the current teacher workforce, the lag in teacher salaries relative to other professions, and the aggressive recruitment practices of school districts outside the state. This section of the data book highlights some of the key forces at work.

K-12 Math-Science Teacher Corps

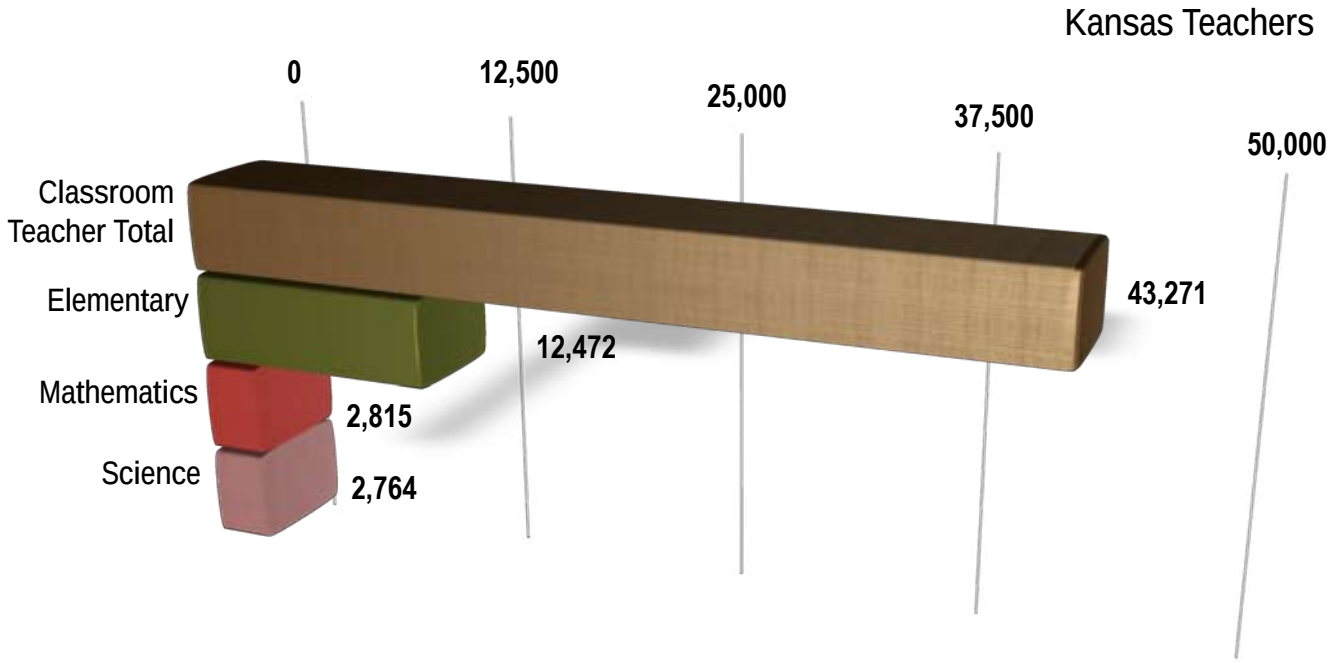
The number of Kansans holding valid teacher credentials is almost double the number that actually teach



Source: KS State Department of Education.

K-12 Math-Science Teacher Corps

The classroom teacher corps includes about 12,500 elementary school and almost 5,600 secondary teachers of math and science



Source: KS State Department of Education.

K-12 Math-Science Teacher Corps

The demand for teachers has been steady in recent years

Kansas Teaching Corps	
Year	Total Licensed Personnel
2001	43,738
2002	44.066
2003	44,296
2004	43,897
2005	43,918
2006	41,882
2007	43,271

Source: Kansas State Department of Education.

K-12 Math-Science Teacher Corps

Returning teachers account for almost 90% of the teacher corps year over year

Statewide Teacher Turnover Information 1990-00 to 2003-04			
Year	Teachers Leaving Kansas Public Schools		
	Non-Retirees	Retirees	Total
1990-00	2,444 7.3%	590 1.8%	3,034 9.1%
2000-01	2,583 7.6%	673 2.0%	3,257 9.6%
2001-02	2,356 6.9%	649 1.9%	3,005 8.9%
2002-03	2,083 6.2%	638 1.9%	2,721 8.1%
2003-04	2,061 6.2%	744 2.2%	2,806 8.4%
Five-Year Average	2,306 6.9%	659 2.0%	2,965 8.8%

Note: may not add up due to rounding.

Source: LPA Analysis of data provided by the Kansas Department of Education and Kansas Public Employees Retirement System.

K-12 Math-Science Teacher Corps

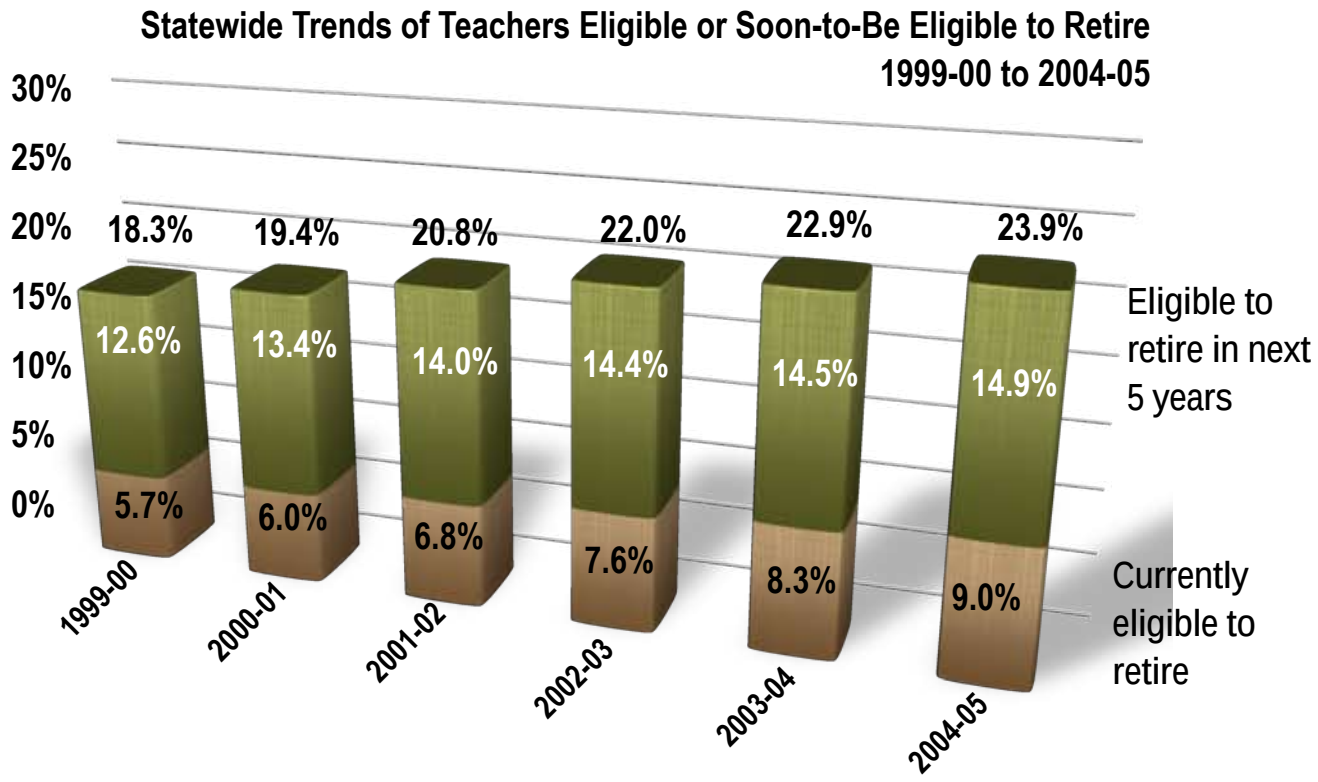
Turnover rates are highest in high-poverty areas

Statewide Teacher Turnover Information **by type of district (2003-04)**			
	Teachers Leaving Kansas Public Schools		
	Non-Retirees	Retirees	Total
High Poverty	561 7.0%	234 2.9%	795 9.9%
Rural	351 5.8%	136 2.3%	487 8.1%
Other	1,149 6.0%	375 2.0%	1,524 8.0%
Overall	2,061 6.2%	744 2.2%	2,806 8.4%

Source: LPA Analysis of data provided by the Kansas Department of Education and Kansas Public Employees Retirement System.

K-12 Math-Science Teacher Corps

Almost one-quarter of the teacher corps will become retirement eligible within five years



Source: LPA Analysis of data provided by the Kansas Department of Education.

K-12 Math-Science Teacher Corps

The traditional pre-service track produces far more licensed math and science teachers than alternative licensure

Track 1: Traditional Pre-Service*

- Hold a bachelor's degree from an accredited college or university
- Complete a state-approved teacher preparation program
- Pass a subject or grade level content assessment
- Pass a pedagogy assessment
- Receive conditional two-year license
- Receive professional license

Track 2: Alternative Licensure**

- Hold a bachelor's degree from an accredited college or university in the content area to be taught or a degree with equivalent coursework
- Collaborate with a mentor teacher, the school district, and a teacher preparation institution
- Receive a three-year restricted license to teach full-time in an area of demonstrated content knowledge
- Complete professional teaching skills coursework (usually online)
- Receive conditional two-year license
- Receive professional license

* Track 1 completion, 2005-06: 75 math and 50 science

** Track 2 completion, 2005-06: 7 math and 11 science

Source: Kansas Department of Education.

K-12 Math-Science Teacher Corps

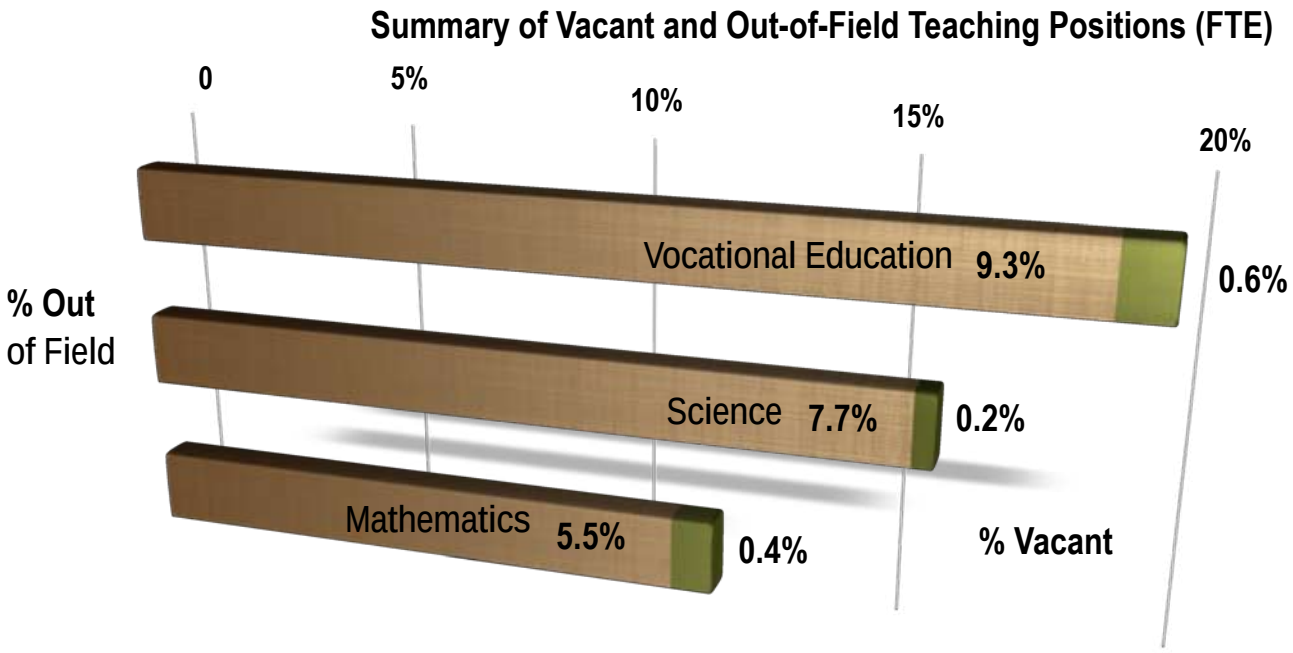
Although more than 90% of the teacher corps meet the "highly qualified" standard, lesser percentages of math and science teachers meet that requirement

2007 Licensed Personnel Report NCLB - Highly Qualified by Class					
		Fully Licensed		NCLB Highly Qualified	
	Total	Number	Percent	Number	Percent
Elementary	20,278	19,704	97.2	19,704	97.2
Fine Arts	15,536	14,434	92.9	13,974	89.9
Foreign Language	3,856	3,274	84.9	3,216	83.4
History/Govt.	9,755	9,113	93.4	8,832	90.5
Language Arts	16,755	15,423	92.1	14,286	85.3
→ Mathematics	13,578	12,203	89.9	11,653	85.8
→ Science	11,497	9,943	86.5	9,578	83.3
ESL/Bilingual	1,444	1,158	80.2	1,158	80.2
Special Ed.	6,808	5,395	79.3	5,370	78.9
Total Assignments	99,507	90,650	91.1	87,771	88.2

Source: Kansas State Department of Education.

K-12 Math-Science Teacher Corps

The shortage of qualified teachers in math, science, and vocational education forces districts to rely on less-qualified out-of-field teaching personnel

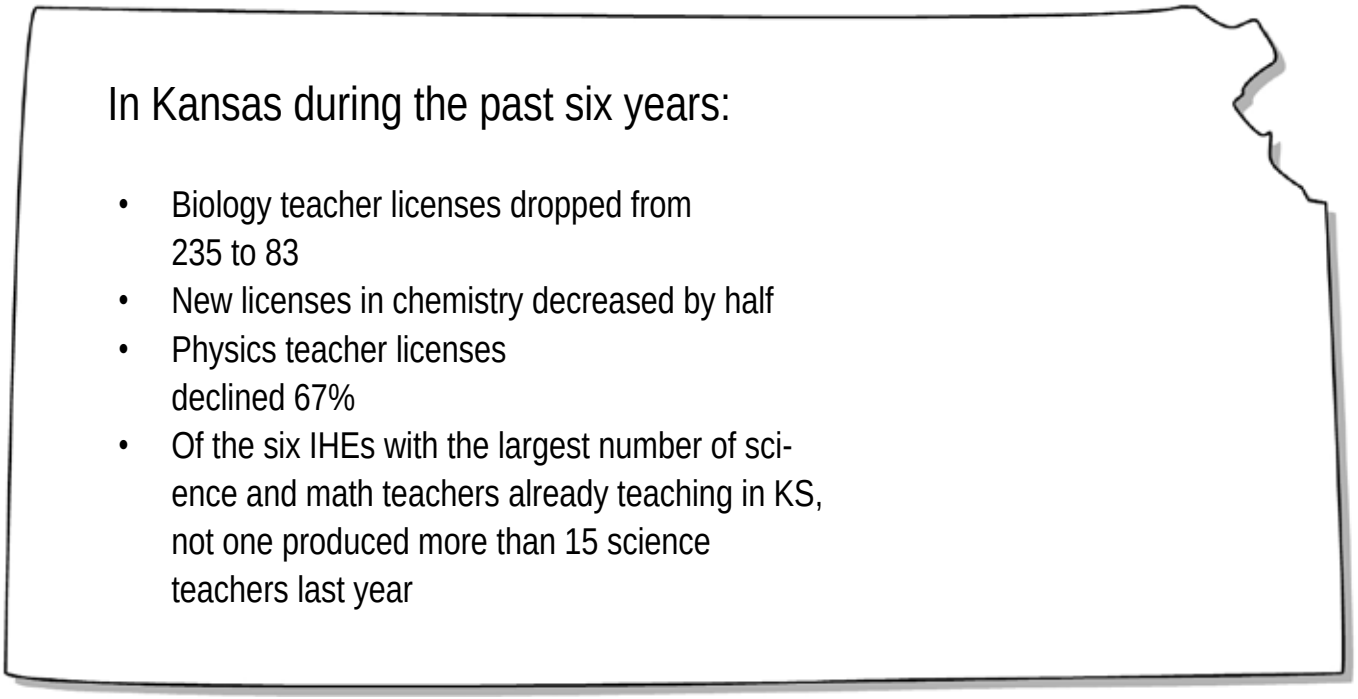


Note: This includes teachers assigned to teach family and consumer science, industrial arts, and vocational education.

Source: Legislative Division of Post Audit State of Kansas: School District Performance Audit Report, April 2007.

K-12 Math-Science Teacher Corps

The number of newly credentialed science teachers has declined sharply in recent years



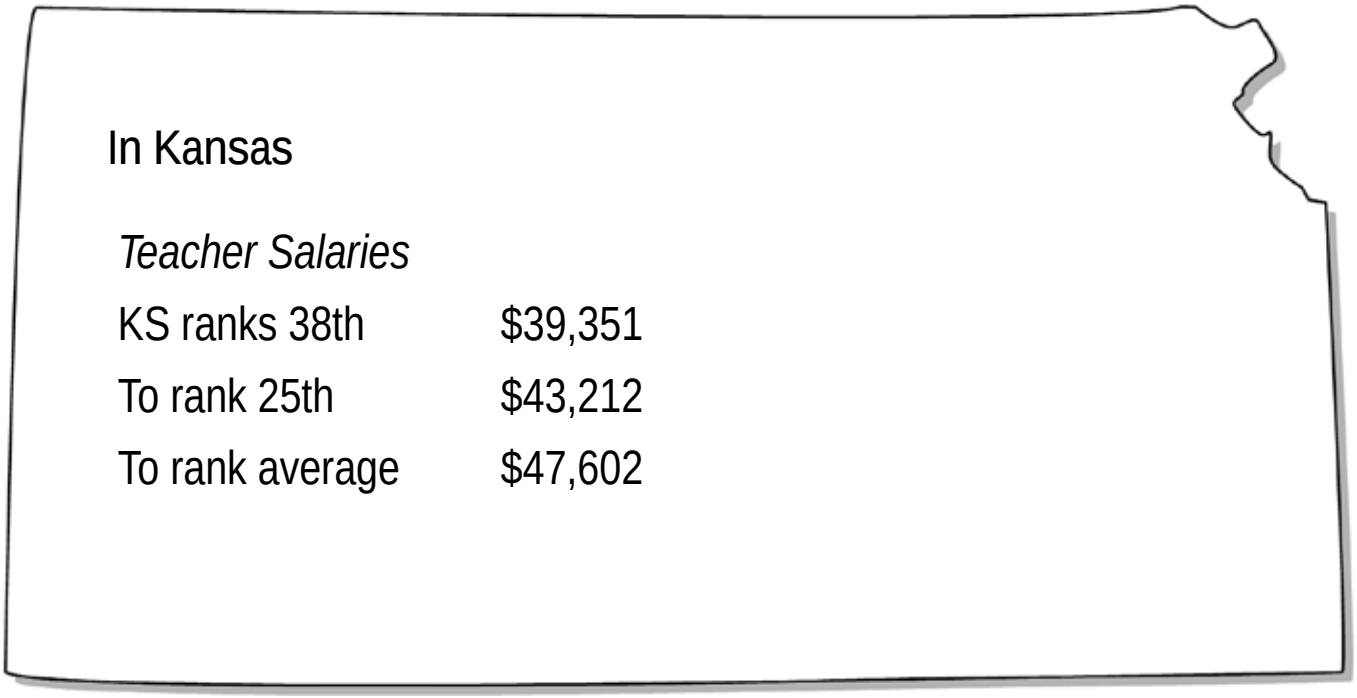
In Kansas during the past six years:

- Biology teacher licenses dropped from 235 to 83
- New licenses in chemistry decreased by half
- Physics teacher licenses declined 67%
- Of the six IHEs with the largest number of science and math teachers already teaching in KS, not one produced more than 15 science teachers last year

Source: Kansas State Department of Education.

K-12 Math-Science Teacher Corps

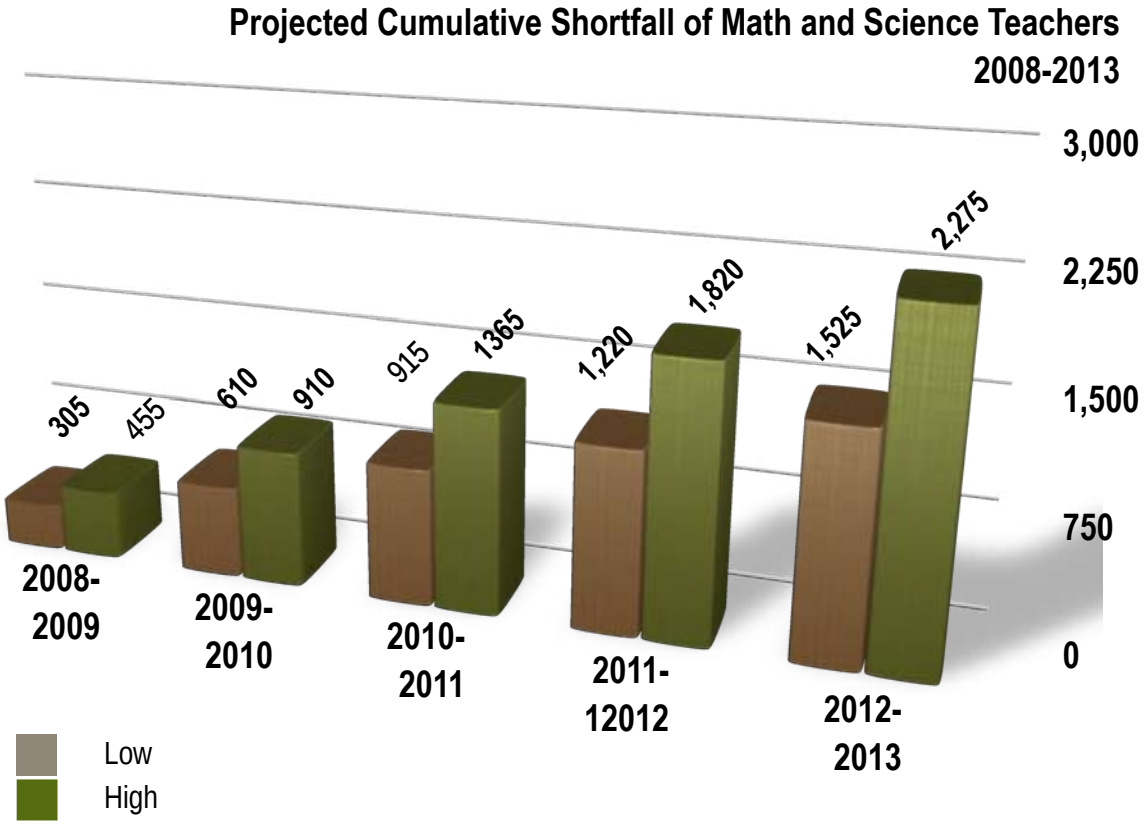
Teachers in Kansas are paid less than the national average



Source: Kansas Department of Education.

K-12 Math-Science Teacher Corps

The Department of Eduation estimates a shortfall of at least 1,500 math and science teachers over the next five years if current trends continue*



* The projections in this chart are based on the low and high estimates of K-12 math and science teacher vacancies for 2008-09 provided by districts to the Kansas Department of Education.

The Bottom Line

Kansas has reached a crisis point in producing and retaining K-12 math and science teachers

Source: (for graph) Kansas Department of Education.

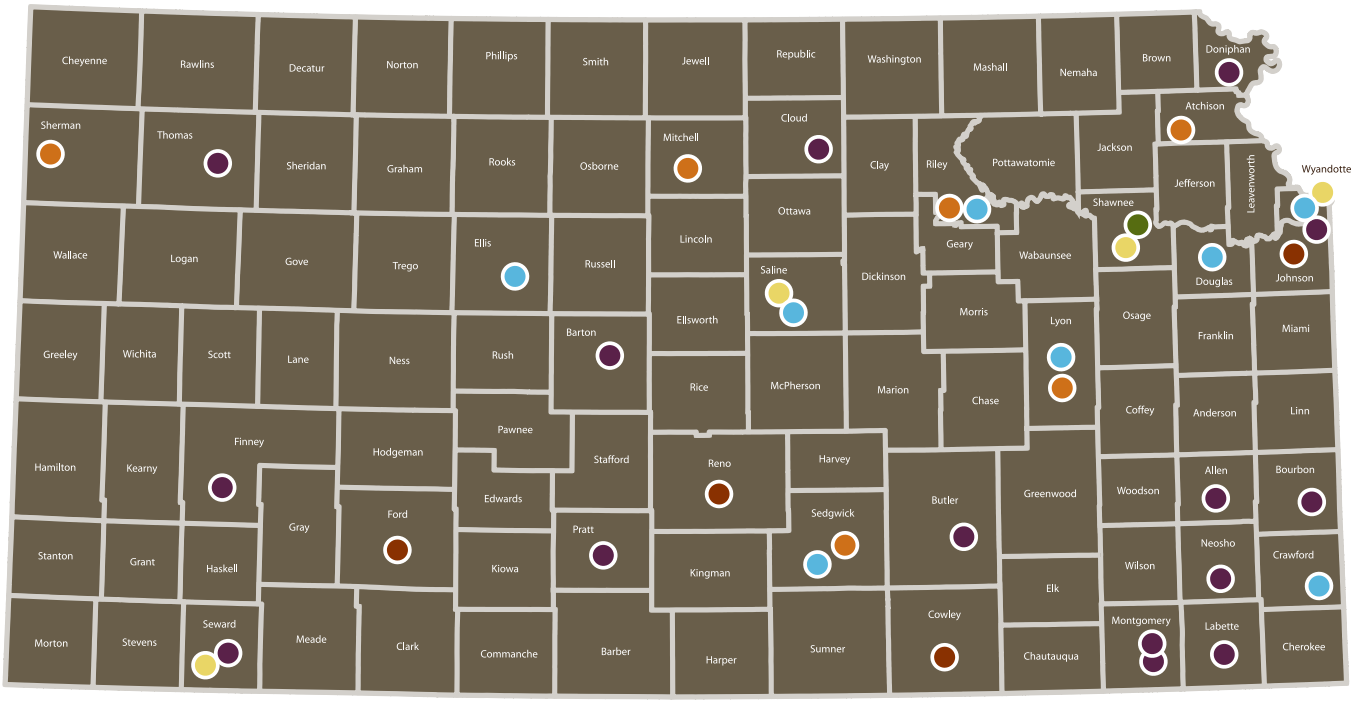
Section V: Post-Secondary Indicators

Institutions of higher education in Kansas provide the bridge between the K-12 system and the METS workplace. They develop both the human and intellectual capital that drives the economy of the state. The higher education enterprise includes 36 public institutions serving a student population of about 200,000. One of the essential roles of these institutions is to ensure that all graduates are sufficiently fluent in math, science, and technology to meet the demands of today's workplace. Another is to produce a specialized talent pool with quality and depth to support Kansas' prosperity. In addition, the state's three research universities have the mission of generating knowledge that can be translated into high-value products and services. The indicators in this section put into perspective the capacity of Kansas' institutions of higher education to produce METS talent.

Post-Secondary Indicators

Thirty-six public post-secondary institutions contribute to building the state's capacity in technical fields

State Universities
Municipal University
Community Colleges
Technical Colleges
Technical Schools



Source: Kansas Board of Regents.

Post-Secondary Indicators

Kansas state investment per full-time student in higher education is less than most states

Kansas Investment Per Student			
	State	Approp. per FTE	Percentile Rank
High	Alaska	$12,413	100.0
	Nebraska	$5,801	59.1
	Missouri	$5,793	57.1
	Arkansas	$5,769	53.0
	Kansas	**$5,448**	**38.7**
	Oklahoma	$5,110	32.6
Low	Colorado	$2,827	0.0
	Average	*$5,540*	

Source: Kansas Board of Regents.

Post-Secondary Indicators

The Board of Regents provides a structure for integrated coordination of post-secondary education

Kansas Board of Regents			
Governed Institutions	Coordinated Institutions		
Emporia State Univ.	Washburn Univ.	Community Colleges	Technical Institutions
Fort Hays State Univ.		Allen Cty CC	Flint Hills TC
Kansas State Univ.		Barton Cty CC	Manhattan Area TC
University of Kansas		Butler Cty CC	N. Central Area TC
Pittsburg State Univ.		Cloud Cty CC	NE KS Area TC
Wichita State Univ.		Coffeyville CC	NW KS Area TC
		Colby CC	Wichita Area TC
		Cowley County CC	
		Dodge City CC	
		Fort Scott CC	Kansas City Area TS
		Garden City CC	Kaw Area TS
		Highland CC	Salina Area TS
		Hutchinson CC	SW Area TS
		Independence CC	
		Johnson Cty CC	TC = Technical College
		Kansas City KS CC	
		Labette CC	TS = Technical School
		Neosha CC	
		Pratt CC	
		Seward CC	

Source: Kansas Board of Regents.

Post-Secondary Indicators

Together, two and four-year institutions serve a large and diverse student population

Fall 2006 Enrollment in Secondary Education	
Public 4-year	96,659
Public 2-year and less*	76,614
Independent 4-year	23,894
Independent 2-year and less	984
	197,464
* includes community colleges, technical colleges, and technical schools; IPEDS fall 2008 data used for technical schools	
** includes Haskell University (federal institution)	

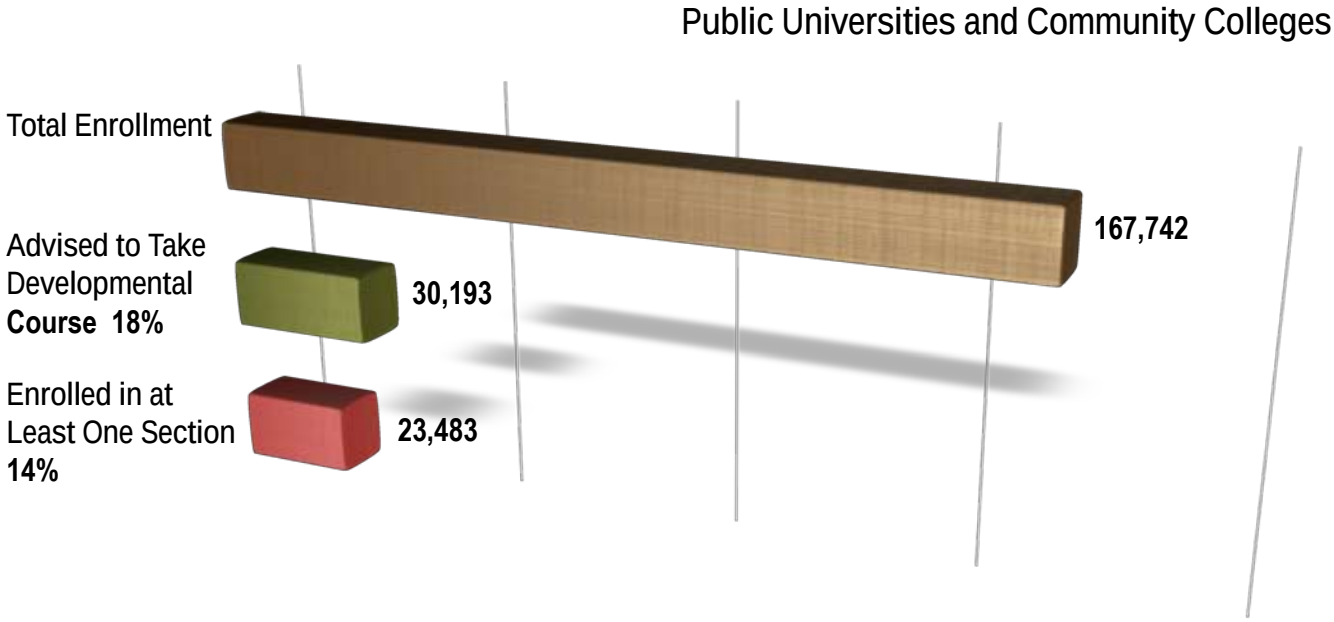
Average Age of Enrolled by Institution Sector	
State University	23 years old
Community College	28 years old

Enrollment by Race/Ethnicity **and Institution Sector (%)**		
	Universities	Comm. Colleges
White	75	77
African-American	3	7
Hispanic	3	5
Unknown	8	6
Other	11	4
	100	**100**

Source: Kansas Board of Regents.

Post-Secondary Indicators

Post-secondary institutions provide developmental math education for a large number of under-prepared students



Source: Kansas Board of Regents.

Post-Secondary Indicators

Two-year institutions respond to needs for general and technical education as well as local workforce requirements

Kansas Board of Regents					
Associate Degrees Awarded - Specific Majors					
	2002	2003	2004	2005	2006
Total Associate Degrees	5,558	6,074	6,494	6,534	6,429
General Studies Majors	1,509	2,198	3,142	3,189	3,232
Science Majors	259	237	156	185	145
Engineering Majors	122	102	70	56	53
Mathematics Majors	6	10	3	4	9

Note: Institutions have reported a decrease in STEM-related Associate Degrees over the five-year period. In 2003-2004 a reporting change occurred where Community Colleges started to report STEM Majors in the broader Major of General Studies. However, one cannot conclude that the large increase in General Studies Majors in 2004 and later can be attributed to the change in reporting STEM Majors, because the General Studies Major includes other Majors or Areas of Study (Psychology, History, English, etc.) at the Associate Degree level.

Source: U.S. Department of Education, IPEDS Completion Surveys.

Post-Secondary Indicators

Large number of students change from one Kansas post-secondary institution to another

Transfer Pathways into Four-Year Institutions					
Number of Students Enrolled in Fall 2003 at One Institution, who then Enrolled in a Different Institution, by Institution Sector					
	Fall 2004 Institutions				
Fall 2003 Institutions	Universities	Community Colleges	Technical Colleges	Technical Schools	Grand Total
Universities Total	1,385	1,743	66	14	**3,208**
Community Colleges Total	6,631	1,665	233	67	**8,596**
Technical Colleges Total	51	206	2	0	**259**
Technical Schools Total	80	87	3	0	**170**
Grand Total	**8,147**	**3,701**	**304**	81	**12,233**

Source: Kansas Board of Regents.

Post-Secondary Indicators

The state's major institutions of higher education play a distributed role in the preparation of K-12 math and science teachers

Traditional Program Completers				
Institution		**2004**	**2005**	**2006**
Emporia State University	math	5	5	13
	science	11	5	4
Fort Hays State University	math	14	1	3
	science	8	5	0
Kansas State University	math	16	15	13
	science	8	10	10
Pittsburg State University	math	6	9	10
	science	6	10	6
University of Kansas	math	12	12	13
	science	6	12	12
Washburn University	math	2	6	2
	science	2	2	1
Wichita State University	math	4	4	5
	science	2	4	5

Source: HEA Title II.

Post-Secondary Indicators

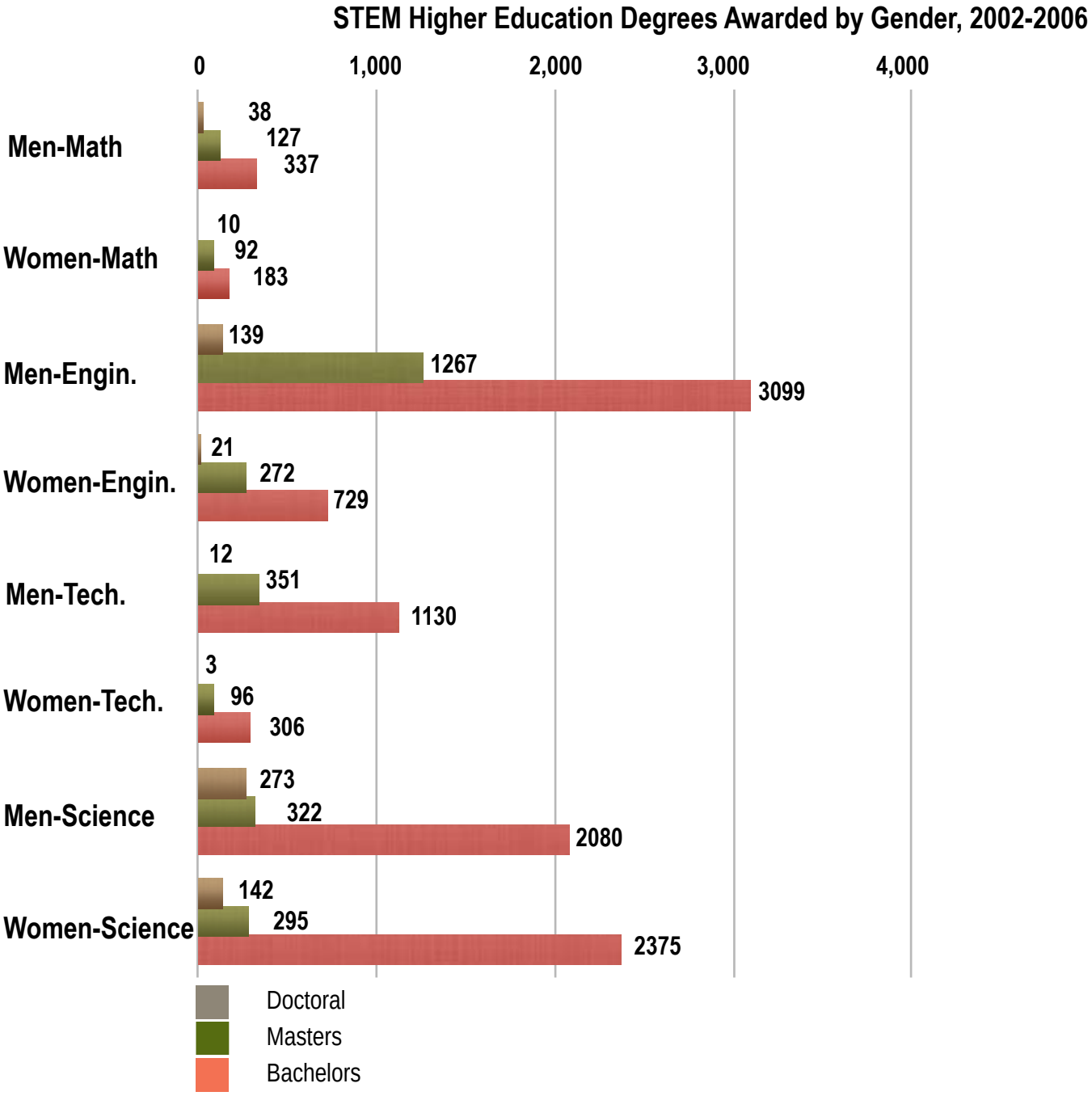
The state's production of baccalaureate and advanced degrees in technical field has remained flat in recent years in spite of rising overall enrollment

Kansas Board of Regents						
Degrees Awarded in METS Categories Statewide Totals, Academic Years 2002-2006						
Institution	Degree Level	2002	2003	2004	2005	2006
Emporia State University	Bachelor's	68	98	90	63	66
	Master's	6	15	11	8	11
	Total	*74*	*113*	*101*	*71*	*77*
Fort Hays State University	Bachelor's	103	92	76	51	56
	Master's	10	11	9	13	8
	Total	*113*	*103*	*85*	*64*	*64*
Kansas State University	Bachelor's	610	822	771	794	798
	Master's	117	167	179	203	188
	Doctoral	56	58	62	61	67
	Total	*783*	*1,047*	*1,012*	*1,058*	*1,053*
Pittsburg State University	Bachelor's	62	90	86	87	87
	Master's	3	17	13	9	10
	Total	*65*	*107*	*99*	*96*	*97*
University of Kansas Main Campus	Bachelor's	615	676	683	676	664
	Master's	165	181	196	168	174
	Doctoral	39	45	27	21	32
	Total	*819*	*902*	*906*	*865*	*870*
University of Kansas Medical Center	Bachelor's	0	16	2	2	3
	Master's	0	4	11	10	14
	Total	*0*	*20*	*13*	*12*	*17*
Washburn University	Bachelor's	66	43	39	32	45
	Total	*66*	*43*	*39*	*32*	*45*
Wichita State University	Bachelor's	298	331	307	329	261
	Master's	92	158	232	216	173
	Doctoral	22	7	7	11	6
	Total	*412*	*496*	*546*	*556*	*440*

Source: U.S. Dept. of Education, IPEDS Completions Survey, 2002-2006.

Post-Secondary Indicators

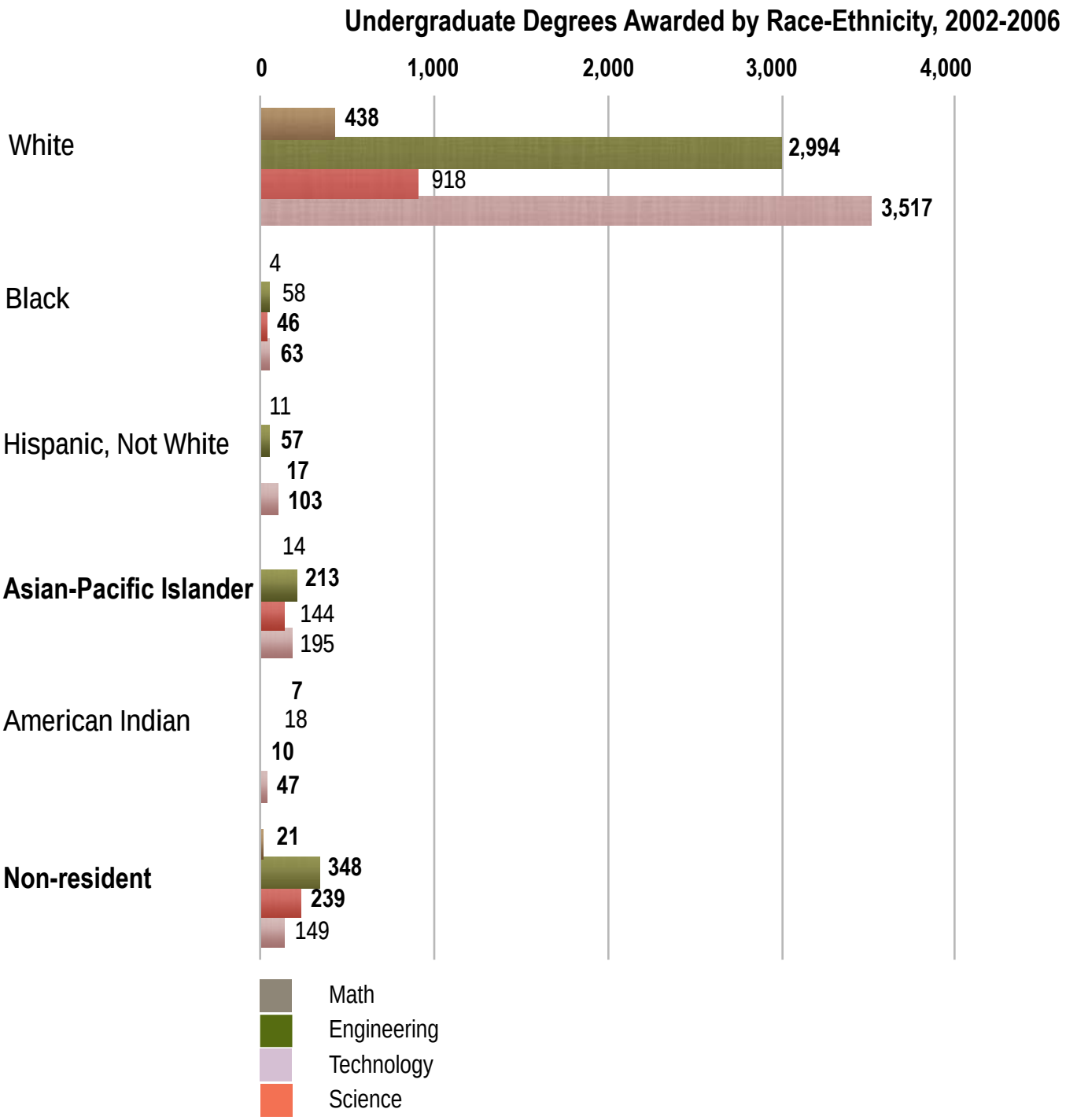
Women now earn more bachelor's degrees in science than men, but remain significantly underrepresented in engineering, technology and mathematics



Source: U.S. Department of Education, IPEDS Completion Survey.

Post-Secondary Indicators

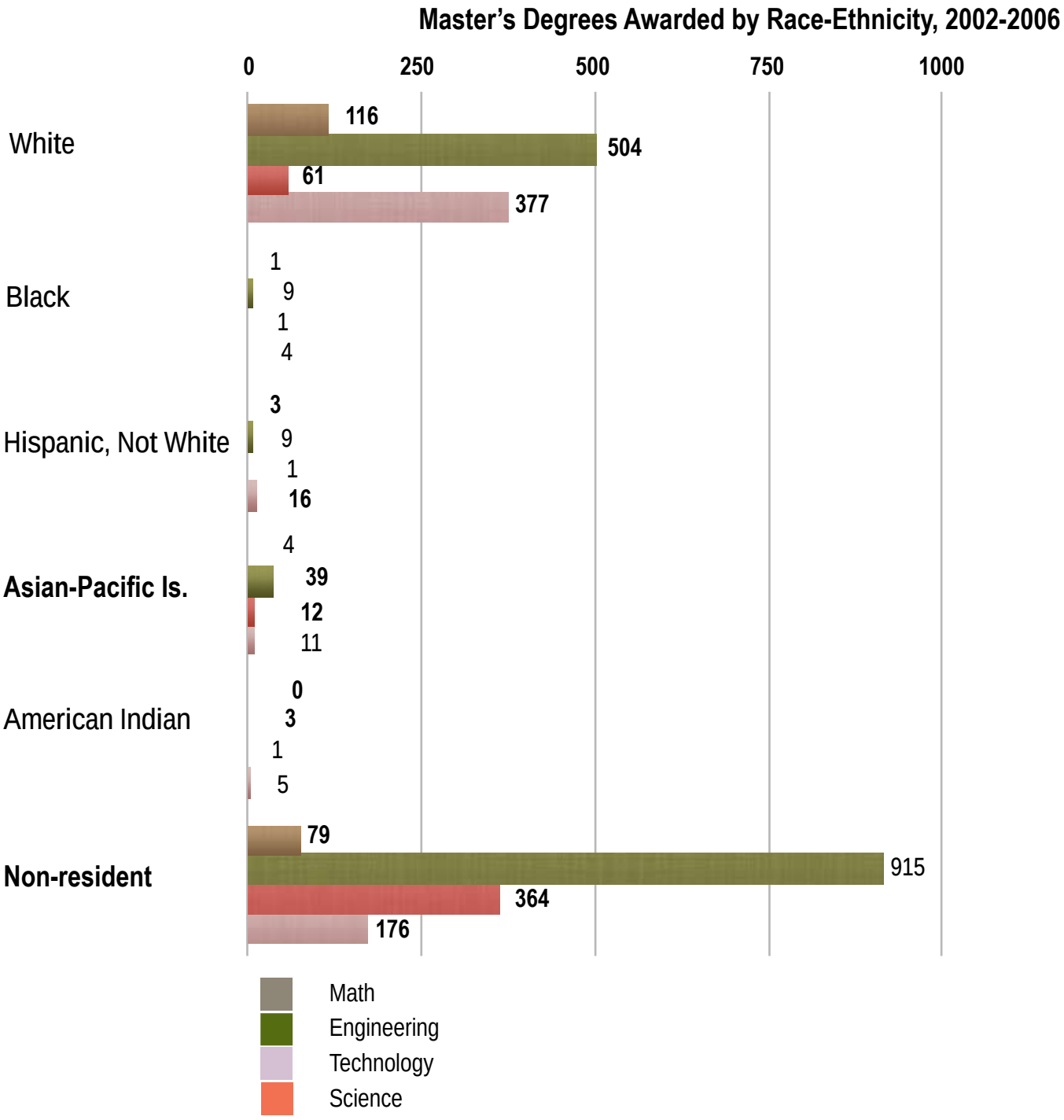
African Americans and Hispanics are strikingly underrepresented in METS degree production



Source: U.S. Department of Education, IPEDS Completion Survey.

Post-Secondary Indicators

Non-U.S. residents earn a high share of advanced degrees in technical fields



Source: U.S. Department of Education, IPEDS Completion Survey.

Post-Secondary Indicators

The R&D expenditures of the state's three research universities are comparatively low

R&D Expenditures at Universities and Colleges									
ranked by FY 2005 R&D Expenditures, FY 1998-2005, $ in thousands									
Rank	Institution	1998	1999	2000	2001	2002	2003	2004	2005
	All	25,857,149	27,532,203	30,069,991	32,805,014	36,384,500	40,074,699	43,228,773	45,750,413
83	U. KS all campuses	117,115	132,752	148,670	156,467	172,131	173,024	181,192	190,105
112	KS State U	81,233	85,580	91,790	94,030	106,804	112,733	119,306	123,398
192	Wichita State U	13,117	14,555	16,213	16,142	18,842	22,401	29,948	32,726

Research Expenditures per Full-Time Faculty	
Public research, Fall 2005	
Kansas	$70,357
U.S. Average	$88,566

The Bottom Line

Kansas' higher education enterprise is stronger in METS degree production than research and development

Sources: (from top) National Science Foundation/Division of Science Resources Statistics, Kansas Board of Regents.

Appendix I

Math and Science Education Advisory Committee		
Legislators	Business Leaders	Education Community Leader
Sen. Nick Jordan, chair Rep. Kenny Wilk, co-chair	Mitch Counce, general manager Servi-Tech	Kenneth Clouse, president Northwest Kansas Technical College
Sen. Laura Kelly	Dan Jacobsen, president AT&T Kansas	Edward Hammond, president Ft. Hays State University
Rep. Shirley Palmer	Richard Taylor Plumbers and Pipefitters Local Union 441	Michael Lane, president Emporia State University
Rep. Sheryl Spalding	Paul Weida, vice president Black & Veatch Corp.	Janis Lariviere Center for Science Education University of Kansas
Sen. Ruth Teichman		